LAB SUPPORT SERVICES
501438X

LORAIN

POWER EQUIPMENT

LORAIN MODEL RHM100D50

FLOTROL RECTIFIER

Spec. No. 5454-010 Serial No. 1077

INSTRUCTIONS

INSTALLATION

OPERATION

MAINTENANCE

RELIANCE COMM/TEC

LORAIN MODEL RHM100D50

FLOTROL RECTIFIER

Spec. No. 5454-010 Serial No. 1077

THIS FLOTROL RECTIFIER IS ADJUSTED

TO 52.1 VOLTS. 2.17 VOLTS PER CELL

FOR A 24 CELL BATTERY. INPUT 240 VAC

OPTIONAL WIRING OR APPARATUS FURNISHED:

A, B, E, G, H, J, K, M, N, Q, R, S, T, V, W, X, Y, Z,

OTHER _____

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If the problem has been created by misuse or abuse of the equipment or by malfunction of associated equipment or by environmental conditions, at any time after shipment, the customer will be billed for circuit component and labor.

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MODEL RHM100D50 FLOTROL® RECTIFIER
SPEC. NO. 5454-010
SPEC. NO. 5454-017
MODEL RHM200D50 FLOTROL® RECTIFIER
SPEC. NO. 5472-014
SPEC. NO. 5472-019
MODEL RHM400D50 FLOTROL® RECTIFIER
SPEC. NO. 5481-036
SPEC. NO. 5481-037
SPEC. NO. 5481-038
SPEC. NO. 5481-041

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1. DESCRIPTION

General

1.01 This FLOTROL® Rectifier is designed to operate from nominal 208 VAC or 240 VAC 60 Hz input, to maintain a battery in a fully charged condition while powering a load.

1.02 Float Charging: The RHM Series rectifiers provide constant output voltage; therefore, output current remains equal to load current as long as load current does not exceed a predetermined, adjustable value. This mode of operation is known as float charging. Since, in normal operation, the battery is not required to furnish load current, it remains in a fully charged condition.

1.03 Equalize Charging: If a higher DC voltage is required to equalize the charge on all battery cells, the FLOAT/EQUALIZE switch can be operated locally to obtain higher equalize charge voltage. The equalize function may also be controlled from a remote location if desired.

1.04 Current Limiting: When an AC power failure causes battery discharge, or if a DC overload occurs, an output current limiting circuit prevents the increase of output current above a predetermined value.

1.05 Paralleling: The RHM Series rectifiers are equipped with an automatic current limiting circuit. This circuit enables the paralleling of an RHM Series rectifier with any other battery charger which can be adjusted to the same output voltage. In addition, a forced load sharing circuit is furnished which ensures proportional sharing of load between paralleled rectifiers with compatible load sharing circuits when inter-connected with external load sharing wiring.

1.06 Overvoltage Shutdown: If rectifier output voltage increases beyond a preset value while delivering greater than 3% of rated output current, a circuit trips open the AC INPUT switch to disable rectifier output.

2. TEST APPARATUS

2.01 The test equipment listed below is sufficient to perform any test or adjustment procedure detailed in this instruction manual.

Description	Model
Power Supply	Power Mate Model BPA 60D (0-60 VDC at 1.2 amp) or equivalent
Test Load	Dependent upon rectifier current rating
Digital Multimeter	Fluke, Model 8022A, or equivalent
AC Ammeter	0-60 amps
Oscilloscope	Tektronix Model T921, or equivalent
Insulated Screwdriver	General Cement Type 8728A, or equivalent

3. INSTALLATION

Physical Considerations

3.01 Equipment placement at the central office location should be given consideration, as discussed in the following paragraphs.

3.02 Relay Rack Mounting (Models RHM100D50 and RHM200D50 only):

a) A 19 inch wide rectifier may be mounted in a relay rack with 1.75 inch multiple drilling, and a 23 inch wide rectifier may be mounted in a relay rack with either 1.0 inch or 1.75 inch multiple drilling.

b) Adapter plates to permit mounting of these rectifiers in 30 inch wide relay racks are available for all models except Models RHM100D50, Spec. No. 5454-017 and RHM200D50, Spec. No. 5472-019.

NOTE

There are two types of 30 inch relay racks in use. They are Channel and Unistrut type. The adapter plates for each are not interchangeable.

c) The Model RHM100D50 Rectifier, Spec. No. 5454-017, and the Model RHM200D50 Rectifier, Spec. No. 5472-019, are equipped with specially designed adapter plates which permit mounting of the rectifier in a Northern Telecom Inc. DMS-10 Power Bay. Refer to the Power Data Sheet for mounting details.

3.03 Wall Mounting (Models RHM100D50 and RHM200D50 only): The relay rack mounting angles furnished with these models may be positioned at the rear of the cabinet to form a 23 inch wide unit. The unit may be mounted on any wall capable of supporting the load. Rectifier weights are listed as follows for convenient reference:

RHM100D50 - 285 lbs.

RHM200D50 - 460 lbs.

3.04 The Model RHM400D50 Rectifier is designed exclusively for floor mounting. The base of this rectifier model is drilled to accommodate four mounting bolts to secure the rectifier in position. The Model RHM100D50 and RHM200D50 Rectifiers may also be floor mounted by using accessory floor stands. Refer to the Power Data Sheet for further information.

3.05 Ventilation Requirements

a) Rectifiers should be mounted so ventilating openings are not blocked and air entering the cabinets does not exceed +50° C (+122° F).

b) If the rectifier is mounted above or between other heat producing equipment, a minimum spacing of 5.25 inches between units is required. Baffle plates between equipment cabinets may be necessary to avoid overheating. Heat dissipation of rectifiers covered in this manual is listed as follows:

RHM100D50 - 3185 BTU/hr

RHM200D50 - 5825 BTU/hr

RHM400D50 - 7400 BTU/hr

Initial Startup and Checkout

3.06 When placing the rectifier into service, it should be adjusted and checked to assure proper operation. Use the following procedure:

a) Preparing to Start (Initially)

1) Operate the rectifier AC INPUT switch and the BATTERY DISCONNECT switch (Models RHM100D50 and RHM200D50 only) to the OFF position and operate the FLOAT/EQUALIZE switch to the FLOAT position.

NOTE

In the Model RHM400D50 Rectifier, the output disconnect device is not a switch but a removable link designated BATTERY DISCONNECT. This link should be removed before proceeding.

2) Insure that the proper fuse sizes are provided and removed from the rectifier. Refer to paragraph 4.13 for correct fuse sizes.

NOTE

The DC OUTPUT fuse F1 is bolted into the unit and may be checked for proper fuse size without removing the fuse from the unit.

3) Make all installer connections in accordance with the Power Data (PD) Sheet furnished with this manual. Refer also to paragraph

3.07 through 3.18 for further reference information.

4) Insure that the rectifier power transformer tap adjustments are correct for the prevailing AC input voltage. Refer to paragraph 5.03 of this instruction for voltage tap adjustments.

b) Rectifier Startup and Checkout

1) Install all fuses, insure that the external AC distribution fuses are correct, and close the output disconnect device. On Models RHM100D50 and RHM200D50, operate the BATTERY DISCONNECT switch to the ON position. In the Model RHM400D50 Rectifier, install the BATTERY DISCONNECT link.

2) Apply AC input power by closing the external AC distribution fuses or circuit breaker, and operating the AC INPUT switch on the rectifier to the ON position. The rectifier should start and the output voltage should be within the range of 48 to 54 VDC.

3) Check the rectifier current limit circuitry by loading the rectifier to at least 120% of the rated output of the unit. If the existing load is less than rated load, a resistive test load may be connected to the DC output terminals of the rectifier. The rectifier should limit its output current at 110% of rated output. If adjustment is required, refer to paragraph 5.06 of this manual. Remove the test load after check or adjustment.

4) The float output voltage of the rectifier should be checked and adjusted to meet load conditions. Unless otherwise specified, the rectifier has been factory adjusted to provide 52.08 VDC during float operation. This is based on a float charge of 2.17 volts per cell for a 24-cell battery. When charging a 23-cell battery, or when a higher or lower voltage per cell is desired, the float output voltage can be changed by adjusting the FLOAT ADJUST potentiometer, accessible through a hole in the front panel of the rectifier. Turn the potentiometer adjustment screw slowly clockwise or counterclockwise as necessary. Voltage should be monitored at the battery while adjusting float output. The rectifier thereby compensates for distribution losses, and the battery remains fully charged.

5) Operate the rectifier FLOAT/EQUALIZE switch to the EQUALIZE position and note the equalize output voltage. Unless otherwise specified, the rectifier has been factory adjusted to provide 54 VDC during equalize charge operation. This is based on an equalize charge of 2.25 volts per cell for a 24-cell battery. When charging a 23-cell battery, or when a higher or lower voltage per cell is desired, the equalize output voltage can be changed by adjusting the EQUALIZE ADJUST potentiometer, accessible through a hole in the front panel of the rectifier. Turn the potentiometer adjustment screw slowly clockwise or counterclockwise as necessary. Voltage should be monitored at the battery while adjusting equalize output, thereby allowing the rectifier to compensate for distribution losses.

6) Return the FLOAT/EQUALIZE switch to the FLOAT position. Before placing the rectifier into service, refer to Table 3-1 and note the factory settings of the overvoltage shutdown circuit and the high and low voltage alarm circuit. If these factory settings are acceptable, the rectifier may be placed into service. If readjustment of these circuits is required to meet customer requirements,

follow the appropriate adjustment procedure referenced in Table 3-1 before placing the rectifier into service.

Adjustment	Factory Setting (VDC)	Adj. Procedure Para. No.
Overvoltage Shutdown	55	5.10
High Voltage Alarm	57.6	5.08
Low Voltage Alarm	47.15	5.07

Table 3-1. Shutdown and Alarm Levels

Electrical Connections

3.07 Wiring: All wiring and branch circuit protection should follow provisions of the current edition of the National Electric Code. Referenced to the 1981 edition for specific requirements are:

Article 240-6 Branch Circuit Rating

Table 310-16 (75° C) Ampacity of Power Conductors

DANGER

All rectifiers covered by this instruction manual operate from AC voltage capable of producing severe, perhaps fatal, electrical shock. Before commencing installation, ensure that AC and DC sources are completely disconnected or disabled.

3.08 General

MODELS RHM100D50 AND RHM200D50

To gain access to the installer input and output terminal blocks (TB1 and TB2) and the alarm-control terminal board TB3 of the rectifier, loosen the two twist-type fasteners on the front cabinet door and pivot the door outward on its hinge.

MODEL RHM400D50

To gain access to the installer input and output terminal blocks (TB1 and TB2) and the alarm-control terminal board TB3 of the rectifier, release the two twist-type fasteners on the access door at the top front of the rectifier cabinet and pivot the door downward on its hinge.

3.09 Input Connections: Connect the three phase AC 208/240 volt, 60 Hz, power leads at terminals L1, L2 and L3 on terminal block TB1.

3.10 Output Connections: Connect DC output leads to output terminals POS and NEG on terminal block TB2.

3.11 Earth Ground (Green Wire) Connections: A frame ground lug (GND), located near terminal block TB1, must be connected to an earth ground (green wire). Do not connect to power system neutral.

Alarm and Control Connections

WARNING

Polarity of the voltage sensing leads is critical. When connecting these leads, verify connections carefully to assure correct polarity, terminal 1 (+) and 2 (-) on terminal board TB3.

3.12 Local or Remote Voltage Sensing: Terminals 1 (positive) and 2 (negative) on terminal board TB3 are provided as voltage sensing terminals. These terminals may be connected at the output of the rectifier or extended to sense the voltage at a remote location. To achieve the most effective regulation of output voltage, the sense leads should be extended to the battery or power board at which regulation is required.

NOTE

The high voltage shutdown circuit is connected across the output voltage leads.

3.13 Load Sharing: This rectifier is equipped with a negative load sharing circuit

which will enable it to divide the load in proportion to the output current ratings, with any other rectifier equipped with a compatible circuit. When both rectifiers have compatible load sharing circuits, a load sharing connection should be made between the load sharing terminals of each rectifier. The load sharing terminal of these rectifiers is located at terminal board TB3 terminal 3. Refer to the Power Data Sheet for recommended size of the load sharing lead and terminal block capacity. For proper operation, it is essential that each rectifier be adjusted per Para. 5.11.

3.14 Remote Equalize Control: The equalize mode of operation can be remotely controlled by providing a closed circuit between terminals 4 and 5 of TB3. An open circuit between these terminals restores operational mode control to the FLOAT/EQUALIZE switch on the rectifier front panel.

3.15 Rectifier Fail Alarm: During normal rectifier operation, positive battery is provided at TB3 terminals 9 and 12 to provide an external normal operation indication. If the rectifier is turned off, or in the event of low or high output voltage, loss of input power, or fan failure, positive battery is removed from TB3 terminals 9 and 12 and applied to TB3 terminals 7 and 10 to actuate external rectifier fail alarms.

NOTE

If closed loop actuated alarms are desired, disconnect and insulate the jumper leads from TB3 terminals 8 and 11. Closed loop rectifier fail alarms are then provided at TB3 terminals 7 to 8 and 10 to 11 during a rectifier fail condition.

3.16 Low Current Alarm: When the rectifier is operating normally and supplying greater than 3% of rated output current, positive battery is provided at TB3 terminal 13 to provide an external normal operation indication. If rectifier output decreases below 0.5% of rated current, positive battery is removed from TB3 terminal 13 and applied to TB3 terminal 15 to actuate external low current alarms.

NOTE

If closed loop actuated alarms are desired, disconnect and insulate the jumper lead from TB3 terminal 14. A closed loop low current alarm is then provided at TB3 terminals 14 to 15 during a low current alarm condition.

3.17 Voltmeter Switch Defeat: When furnished from the factory, the rectifier voltmeter will indicate zero volts when the rectifier is turned off. If battery voltage indication is desired with the rectifier off, connect a jumper to TB3 terminals 17 and 18.

3.18 Rectifier Charge Mode Indication: When this rectifier is operating in the float charge mode, positive battery is provided at TB3 terminal 19 to provide an external float charge indication. When the rectifier is operating in the equalize charge mode, positive battery is removed from TB3 terminal 19 and applied to TB3 terminal 21 to provide an external equalize charge indication.

NOTE

If closed loop charge mode indications are desired, disconnect and insulate the jumper lead connected at TB3 terminal 20. During float charge operation, a closed loop is provided at TB3 terminals 19 and 20. During equalize charge operation, a closed loop is provided at TB3 terminals 20 and 21.

4. OPERATION

Starting and Stopping

4.01 The rectifier may be started or stopped by operating the AC INPUT switch, located on the front door, to the ON or OFF position, respectively.

4.02 The rectifier will automatically restart after an AC power failure.

Controls and Indicators

4.03 The following controls and light emitting diode indicators control the operation and indicate the status of the rectifier. All

controls and indicators are located on the rectifier front panel unless otherwise noted.

a) AC INPUT Switch: This switch starts or stops the rectifier when placed to the ON or OFF position, respectively.

b) BATTERY DISCONNECT Device: In Models RHM100D50 and RHM200D50, BATTERY DISCONNECT switch S2 is placed to the OFF position to disconnect the rectifier from the battery. In Model RHM400D50, removal of the BATTERY DISCONNECT link adjacent to the DC output fuse disconnects the rectifier from the battery.

c) FLOAT/EQUALIZE Switch: When this switch is in the FLOAT position, sufficient voltage is provided to maintain the battery in a fully charged condition while supplying load demands. When this switch is placed in the EQUALIZE position, the rectifier output voltage is increased to equalize the charge of all battery cells. Refer to Para. 4.06.

d) *POWER ON Indicator: Illuminates when the AC input voltage is present and the AC INPUT switch is in the ON position.

e) *HIGH VOLTAGE ALARM Indicator: Illuminates when the battery voltage increases to a predetermined adjustable high voltage alarm value. The high voltage alarm circuit monitors the battery voltage continuously; therefore, this alarm is operational even when the rectifier is turned off.

f) *LOW VOLTAGE ALARM Indicator: Illuminates when the battery voltage decreases to a predetermined adjustable low voltage alarm value. The low voltage alarm circuit monitors the battery voltage continuously; therefore, this alarm is operational even when the rectifier is turned off.

NOTE

The LOW VOLTAGE ALARM indicator may illuminate during a battery recharge condition if the rectifier operates in the current limiting mode, and reduces output voltage accordingly. This is normal operation, and the alarm will extinguish as the battery voltage increases.

g) *LOW CURRENT ALARM Indicator: Illuminates when the rectifier is operating and supplying less than 0.5% of rated output current or when the rectifier is turned off.

h) *FUSE ALARM Indicator: Illuminates if one or more fuses F1 through F4 should open.

*During an AC power failure, low current alarm, high or low voltage alarm, failure of fuse F1 or F2, fan failure, or any time the rectifier is turned off either automatically or manually, positive battery is provided for external alarms. (Refer to Power Data Sheet and the installer connection section of this manual for details.)

Metering

4.04 A DC ammeter and a DC voltmeter indicate rectifier output current and voltage, respectively. Pin jacks are also provided for connection of a portable voltmeter.

Float Charging

4.05 The RHM Series Rectifiers provide a constant output voltage; therefore, output current remains equal to load current as long as load current does not exceed the current limit setting. This mode of operation is known as float charging. In normal operation, the battery is not required to furnish load current and remains in a fully charged condition.

NOTE

If the current demand by the load exceeds the current limit setting, the battery is required to furnish the difference and subsequently begins discharging.

Equalize Charge

4.06 Higher charging voltage is sometimes required to equalize the charge of all battery cells. To obtain this voltage, operate the FLOAT/EQUALIZE switch to EQUALIZE position. To restore usual float operation, operate the switch to the FLOAT position.

4.07 The equalize function of the rectifier can also be initiated from a remote location, if desired. (Refer to Power Data Sheet.) When the equalize function is controlled remotely, the FLOAT/EQUALIZE switch on the rectfifier is disabled.

WARNING

Do not supply equalize voltage for a longer period than necessary. Prolonged higher charge voltage will overcharge the battery cells and reduce battery life.

Overvoltage Shutdown

4.08 If rectifier output voltage exceeds a preset adjustable overvoltage limit, the AC INPUT switch opens and automatic rectifier shutdown results. To restart the rectifier after an overvoltage shutdown, simply return the AC INPUT switch to the ON position.

4.09 This rectifier contains a circuit which permits selective overvoltage shutdown when two or more rectifiers are operated in parallel. The circuit allows operation of the overvoltage shutdown circuit only in the rectifier which causes the overvoltage condition.

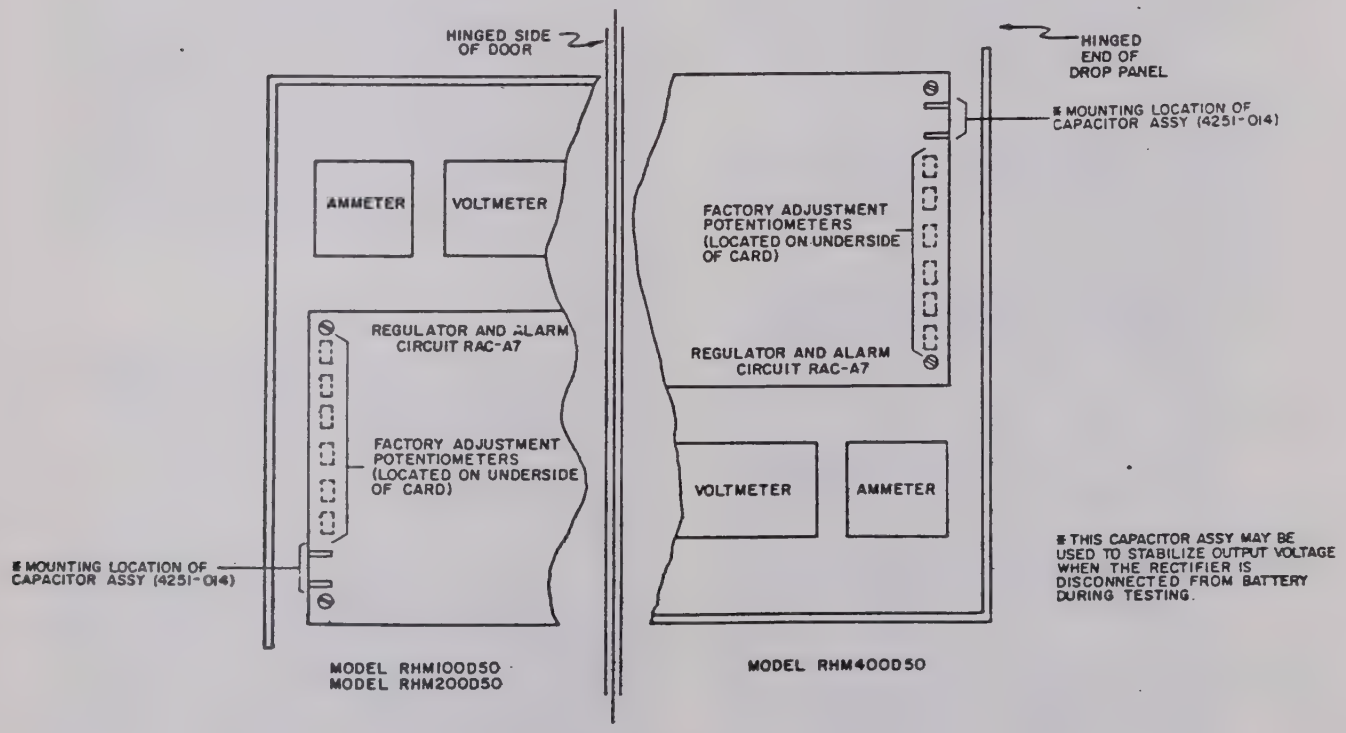

HINGED SIDE OF DOOR
AMMETER
VOLTMETER
REGULATOR AND ALARM CIRCUIT RAC-A7
FACTORY ADJUSTMENT POTENTIOMETERS (LOCATED ON UNDERSIDE OF CARD)
* MOUNTING LOCATION OF CAPACITOR ASSY (4251-014)
MODEL RHM1000D50
MODEL RHM2000D50
HINGED END OF DROP PANEL
* MOUNTING LOCATION OF CAPACITOR ASSY (4251-014)
FACTORY ADJUSTMENT POTENTIOMETERS (LOCATED ON UNDERSIDE OF CARD)
REGULATOR AND ALARM CIRCUIT RAC-A7
VOLTMETER
AMMETER
MODEL RHM4000D50
* THIS CAPACITOR ASSY MAY BE USED TO STABILIZE OUTPUT VOLTAGE WHEN THE RECTIFIER IS DISCONNECTED FROM BATTERY DURING TESTING.

Figure 4-1. Capacitor Assembly Connector Location

Ripple Regulator Circuit

4.10 This rectifier is equipped with a ripple regulator circuit, located on circuit card RR-A11, which continuously monitors the ripple current across the rectifier DC output filter capacitors. In the event of a high ripple current condition caused by the loss of an AC input phase, the ripple regulator circuit senses the high ripple across the capacitors and provides a signal to the rectifier regulation circuitry which reduces rectifier output voltage and current. This permits the rectifier to continue operating at a reduced capacity until such time as the phase loss is corrected.

Batteryless Operation (Ⓜ Option)

4.11 If rectifier operation off battery is required, a capacitor assembly, Part No. 4251-014, should be installed on circuit card RAC-A7 to stabilize rectifier output voltage. See Figure 4-1.

Cooling Fans and Temperature Sensors:
(Model RHM400D50 only)

4.12 The Model RHM400D50 Rectifier is equipped with cooling fans and temperature sensors mounted on heat sink assemblies at the bottom of the cabinet. The cooling fans circulate air through the cabinet to cool the rectifier, while the temperature sensors continually monitor both heatsink and air temperature. If temperature of air flow through the cabinet reaches +75°C (+167°F) or if heatsink temperature reaches +85° C (+185° F), output current of the rectifier is reduced to less than 66% of the full load rating, and an external rectifier fail alarm is activated, if connected. When the temperature decreases and fans have been repaired, the rectifier returns to full load capability and the external rectifier fail alarm is canceled.

Fuses

4.13 Table 5-1 lists the rating and types for all the fuses used in the rectifier. Fuses should be replaced with the type and size listed, or equivalent.

4.14 To gain access to all fuses in Model RHM100D50 and RHM200D50 Rectifiers, simply open the front access door. To gain access to certain fuses in Model RHM400D50, remove the lower front access panel and open the hinged front panel.

Desig.	Model	Size (Amps)	Type
F1	RHM100D50	150	Chase-Shawmut A25Z150
	RHM200D50	250	Chase-Shawmut A25Z250 Type 4
	RHM400D50	600	Chase-Shawmut A25Z600 Type 4
F2	RHM100D50 RHM200D50 RHM400D50	1 1/3	Bussmann GMT
F3	RHM100D50	20	Bussmann NON
	RHM200D50 RHM400D50	60	Bussmann NON
F4	RHM400D50	60	Bussmann NON
F5 & F6	RHM400D50	5	Bussmann GMT
F5 & F6	RHM400D50 5481-038 only	5	Bussmann MTH
F1A F3A	RHM100D50 RHM200D50 RHM400D50	1/4	Bussmann GMT
F4A	RHM400D50	1/4	Bussmann GMT

Table 5-1. Fuse Types and Sizes

Circuit Cards

4.15 Any of the following circuit cards can easily be replaced as individual assemblies if the need arises.

Circuit Card	Description
A1-A6 (4334-016)	SCR Firing Circuit Card
RAC-A7 (4865-087)	Regulator & Alarm Card
PSA-A8 (4865-622)	Power Supply Card
AI-A9 (4338-362)	Alarm Interface Assy
RR-A11 (4865-644)	Ripple Regulator Card
FFC-A12 (4338-371)	Fan Failure Alarm
FFC-A13	

5. ADJUSTMENTS

General

5.01 The only adjustment that may be required before operating this rectifier is the input voltage adjustment. This adjustment adapts the rectifier to operate from nominal 208 VAC, or 240 VAC input.

5.02 Various adjustment potentiometers are accessible on the front door of the rectifier and inside on Regulator and Alarm Circuit RAC-A7 and Ripple Regulator Circuit RR-A11. These potentiometers are factory adjusted and readjustment is not normally required.

WARNING

1) Adjustment of this rectifier should only be attempted by trained service personnel. Adjustment outside of ranges or beyond limits stated in the Power Data Sheet is not recommended.

2) Before performing any of the adjustment procedures contained in this section of the instruction manual, open the load sharing lead between the rectifier to be adjusted and any paralleled rectifiers. Refer to Para. 3.13 for identification of the load sharing terminal.

Input Voltage Range Adjustment

5.03 This rectifier can be operated from nominal 208V or 240V, three phase, 60 Hz AC service by making various tap adjustments on transformer T1. To gain access to adjustment taps on Models RHM100D50 and RHM200D50, simply open the front access door. To gain access to adjustment taps on Model RHM400D50, remove the protective cover at the bottom front of the rectifier. Make the necessary tap adjustments for the desired AC input voltage as listed in Table 5-2.

DANGER

AC input voltages used in the rectifier can cause severe, perhaps fatal, electrical shock. Insure that AC power is completely removed from the rectifier before attempting input tap adjustments.

Exercise care that no hardware is inadvertently dropped into the rectifier interior during the input tap adjustment procedure. Loose hardware can result in short circuits and permanent equipment damage.

Battery Float Voltage Adjustment

5.04 Potentiometer FLOAT ADJUST is accessible through a hole on the front panel of the rectifier. This potentiometer sets the value of the float output voltage. Unless otherwise specified, the float voltage is factory adjusted to 52.08 VDC (24 cells at 2.17V/cell). The potentiometer setting, if changed, should be done in small increments. Before adjustments are made, verify that the battery is fully charged.

a) To obtain float output voltage, place the FLOAT/EQUALIZE switch in the FLOAT position.

b) To increase float voltage, adjust potentiometer FLOAT ADJUST slowly clockwise. To decrease float voltage, adjust potentiometer slowly counterclockwise.

c) When the setting of potentiometer FLOAT ADJUST has been changed, allow battery voltage to stabilize at its new value, then note whether this value is as desired.

Model	Nom. Input Volt.	Connect Lead Labeled	to XFMR T1
RHM100D50 RHM200D50	208V	D	ØA Term. 6 to ØB Term. 7
		E	ØB Term. 6 to ØC Term. 7
		F	ØC Term. 6 to ØA Term. 7
	240V	D	ØA Term. 6 to ØB Term. 8
		E	ØB Term. 6 to ØC Term. 8
		F	ØC Term. 6 to ØA Term. 8
RHM400D50	208V	D	ØA Term. 7 to ØB Term. 9
		E	ØB Term. 7 to ØC Term. 9
		F	ØC Term. 7 to ØA Term. 9
	240V	D	ØA Term. 6 to ØB Term. 9
		E	ØB Term. 6 to ØC Term. 9
		F	ØC Term. 6 to ØA Term. 9

Table 5-2. Input Voltage Tap Adjustments

NOTE : Unless otherwise specified, the rectifier was factory adjusted for 240 volt input.

d) Repeat Steps b) and c) as necessary to obtain the required float voltage.

NOTE

When the float voltage is adjusted the equalize voltage will be affected. It is recommended that the equalize voltage be checked, and if necessary, readjusted.

Equalize Voltage Adjustment

5.05 Potentiometer EQUALIZE ADJUST is accessible through a hole on the front panel of the rectifier. This potentiometer sets the value of the equalize output voltage. Unless otherwise specified, the equalize voltage has been factory adjusted to 54 VDC (24 cells at 2.25V/cell). The potentiometer setting, if changed, should be done in small increments.

a) To obtain equalize output voltage, place the FLOAT/EQUALIZE switch in the EQUALIZE position.

b) Allow DC output voltage to stabilize at its new value.

c) To increase equalize voltage, adjust potentiometer EQUALIZE ADJUST clockwise. To decrease, adjust potentiometer counterclockwise.

d) Repeat steps b) and c) as necessary to obtain desired equalize voltage.

Current Limit Adjustment

5.06 The value at which the current limit circuit prevents further increase of output current is set by potentiometer CURRENT LIMIT ADJUST accessible through a hole on the front panel of the rectifier. Unless otherwise specified, the rectifier is factory adjusted to current limit at 110% of rated load. To change the current limit setting, observe the following procedure:

WARNING

This rectifier is not rated for continuous duty above 100% of rated current. Loads of up to 125% may be tolerated for short periods of time (e.g., when recharging a discharged battery). Prolonged operation over 100% load may overheat the rectifier and cause permanent damage to some components.

a) If the load on the rectifier is not greater than the desired current limit setting, an artificial load should be used to insure the amount of load exceeds the desired output current limit setting.

b) To decrease the current limit setting, adjust potentiometer CURRENT LIMIT ADJUST counterclockwise until the output current decreases to the desired limit.

c) To increase the current limit setting, adjust potentiometer CURRENT LIMIT ADJUST clockwise until the output current increases to the desired limit.

Low Voltage Alarm Adjustment

5.07 The low voltage alarm adjustment potentiometer R38, located on Regulator and Alarm Circuit RAC-A7, sets the value at which light emitting diode LOW VOLTAGE ALARM illuminates and an external alarm is activated, if connected. Unless otherwise specified, the low voltage alarm is factory adjusted for 47.15 VDC. To readjust this limit, observe the following procedure:

a) Turn off the rectifier by operating the AC INPUT switch to the OFF position.

b) Open the front access door on Models RHM100D50 and RHM200D50 or front access panel on Model RHM400D50. Disconnect the rectifier from battery by operating BATTERY DISCONNECT switch S2 on Models RHM100D50 and RHM200D50 to the OFF position, or by removing the BATTERY DISCONNECT link in Model RHM400D50.

DANGER

Exercise extreme caution when performing Step c). Hazardous DC voltage is present at the DC output terminals and the DC output fuse.

c) Connect an adjustable DC supply capable of supplying 60 volts DC to the positive output terminal (+) and the lower end of fuse F1 (-), observing proper polarity.

d) Adjust potentiometer R38 fully counterclockwise. Refer to Figure 5-1 for location.

e) Turn on the external DC supply and adjust the DC supply to the desired low voltage alarm value.

f) Slowly adjust potentiometer R38 clockwise until light emitting diode LOW VOLTAGE ALARM on the front panel illuminates.

g) As a check, increase the output voltage of the external DC supply; light emitting diode LOW VOLTAGE ALARM should extinguish. Slowly decrease the voltage until light emitting diode LOW VOLTAGE ALARM ILLUMINATES. Repeat Steps d) through g), if necessary, until the alarm is activated at the desired voltage.

h) Remove the external DC supply and reconnect the battery to the rectifier by operating BATTERY DISCONNECT switch S2 to the ON position or inserting the removable BATTERY DISCONNECT link.

High Voltage Alarm Adjustment

5.08 The high voltage alarm adjustment potentiometer R39, located on Regulator and Alarm Circuit RAC-A7, sets the value at which light emitting diode HIGH VOLTAGE ALARM illuminates and an external alarm is activated, if connected. Unless otherwise specified, the high voltage alarm is factory adjusted for 57.6 VDC. To readjust this limit, observe the following procedure:

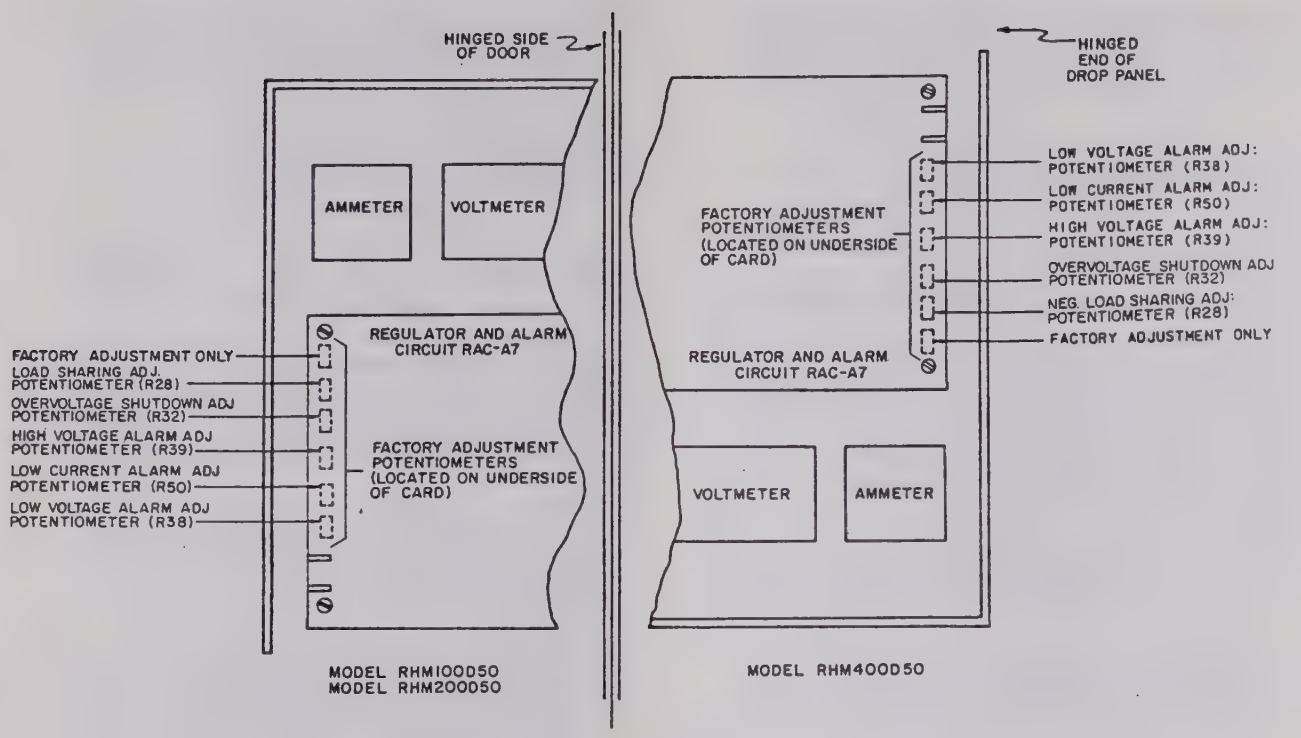

HINGED SIDE OF DOOR
AMMETER
VOLTMETER
REGULATOR AND ALARM CIRCUIT RAC-A7
FACTORY ADJUSTMENT ONLY
LOAD SHARING ADJ. POTENTIOMETER (R28)
OVERVOLTAGE SHUTDOWN ADJ POTENTIOMETER (R32)
HIGH VOLTAGE ALARM ADJ POTENTIOMETER (R39)
LOW CURRENT ALARM ADJ POTENTIOMETER (R50)
LOW VOLTAGE ALARM ADJ POTENTIOMETER (R38)
FACTORY ADJUSTMENT POTENTIOMETERS (LOCATED ON UNDERSIDE OF CARD)
MODEL RHM100D50
MODEL RHM200D50
HINGED END OF DROP PANEL
LOW VOLTAGE ALARM ADJ: POTENTIOMETER (R38)
LOW CURRENT ALARM ADJ: POTENTIOMETER (R50)
HIGH VOLTAGE ALARM ADJ: POTENTIOMETER (R39)
OVERVOLTAGE SHUTDOWN ADJ POTENTIOMETER (R32)
NEG. LOAD SHARING ADJ: POTENTIOMETER (R28)
FACTORY ADJUSTMENT ONLY
FACTORY ADJUSTMENT POTENTIOMETERS (LOCATED ON UNDERSIDE OF CARD)
REGULATOR AND ALARM CIRCUIT RAC-A7
VOLTMETER
AMMETER
MODEL RHM400D50

Figure 5-1. Adjustment Potentiometer Locations

a) Turn off the rectifier by operating the AC INPUT switch to the OFF position.

b) Open the front access door on Models RHM100D50 and RHM200D50 or front access panel on Model RHM400D50. Disconnect the rectifier from battery by operating BATTERY DISCONNECT switch S2 on Models RHM100D50 and RHM200D50 to the OFF position, or by removing the BATTERY DISCONNECT link in Model RHM400D50.

DANGER

Exercise extreme caution when performing Step c). Hazardous DC voltage is present at the DC output terminals and the DC output fuse.

c) Connect an adjustable DC supply capable of supplying 60 volts DC to the positive output terminal (+) and the lower end of fuse F1 (-), observing proper polarity.

d) Adjust potentiometer R39 fully clockwise. Refer to Figure 5-1 for location.

e) Turn on the external DC supply and adjust the DC supply to the desired high voltage alarm value.

f) Slowly adjust potentiometer R39 counterclockwise until light emitting diode HIGH VOLTAGE ALARM on the front panel illuminates.

g) As a check, decrease the output voltage of the external DC supply; light emitting diode HIGH VOLTAGE ALARM should extinguish. Slowly increase the voltage until light emitting diode HIGH VOLTAGE ALARM illuminates. Repeat Steps d) through g), if necessary, until the alarm is activated at the proper voltage.

h) Remove the external DC supply and reconnect the battery to the rectifier

by operating BATTERY DISCONNECT switch S2 to the ON position or inserting the removable BATTERY DISCONNECT link.

Low Current Alarm Adjustment

5.09 The low current alarm adjustment potentiometer R50, located on Regulator and Alarm Circuit RAC-A7, sets the value at which light emitting diode LOW CURRENT ALARM illuminates and an external low current alarm is activated, if connected. Unless otherwise specified, the low current alarm adjustment is factory set to provide an alarm when rectifier output decreases below 0.5% of rated current. To readjust the low current alarm, observe the following procedure:

a) Turn off the rectifier by operating the AC INPUT switch to the OFF position.

b) Disconnect the battery or load from the DC output terminals of the unit, and reconnect the remote voltage sensing leads to the output terminals of the rectifier.

c) Connect an ammeter and suitably sized variable resistive test load in series across the DC output terminals of the rectifier.

NOTE

The test load must be capable of being adjusted for 0.5% of full rated load of the rectifier.

d) Adjust potentiometer R50 fully counterclockwise. Refer to Figure 5-1 for location.

e) Start the rectifier and adjust the test load for a reading of 0.5% full load on the ammeter. The LOW CURRENT ALARM should be extinguished.

f) Slowly adjust potentiometer R50 clockwise until the LOW CURRENT ALARM light emitting diode illuminates.

g) When the adjustment is complete, remove all test equipment, reconnect the load, and extend the remote voltage sensing leads if desired.

Overvoltage Shutdown Adjustment

5.10 This adjustment sets the limit at which the rectifier is shutdown if a high voltage condition occurs. This adjustment is made by overvoltage adjustment potentiometer R32 on Regulator and Alarm Circuit RAC-A7. Unless otherwise specified, the overvoltage shutdown adjustment is factory set at 55.0 VDC. To readjust the overvoltage shutdown limit, observe the following procedure:

a) Turn the rectifier off by operating the AC INPUT switch S1 to the OFF position.

b) Open the front access door on Models RHM100D50 and RHM200D50 or front access panel on Model RHM400D50. Disconnect the rectifier from battery by operating BATTERY DISCONNECT switch S2 on Models RHM100D50 and RHM200D50 to the OFF position, or in the case of the Model RHM400D50, removing the BATTERY DISCONNECT link.

DANGER

Exercise extreme caution when performing Step c). Hazardous DC voltage is present at the DC output terminals and the DC output fuse.

c) If remote voltage sensing leads are extended (Ⓣ Option), disconnect and insulate. Connect internal voltage sensing leads (Ⓡ Option) to terminals 1 (+) and 2 (-) of TB3.

WARNING

Polarity of the voltage sensing leads is critical. When connecting these leads, verify connections carefully to assure correct polarity, terminals 1 (+) and 2 (-) on terminal board TB3.

d) Install Ⓜ option capacitor assembly A10 on circuit card RAC-A7.

e) Connect the test load to the rectifier side of fuse F1 and adjust potentiometer R32 fully clockwise. Refer to Figure 5-1 for location.

f) Restart the rectifier and apply approximately 5% load.

g) Connect a voltmeter capable of measuring 60 VDC to monitor jacks TP1 and TP2 and note the float and equalize output voltage settings.

h) Adjust the output voltage by means of potentiometer FLOAT ADJUST to the value at which overvoltage shutdown is desired. If the desired output voltage cannot be obtained with the float potentiometer alone, place the FLOAT/EQUALIZE switch in the EQUALIZE position. Continue to increase the output voltage using the EQUALIZE ADJUST potentiometer.

i) Slowly adjust potentiometer R32 counterclockwise until the input switch trips.

j) As a check, turn the FLOAT and/or the EQUALIZE ADJUST potentiometer down. Turn the input switch ON. Slowly increase the output voltage until the input switch trips at the proper voltage. Repeat, if necessary, until the input switch trips at the proper voltage.

k) Disconnect the test load, Ⓜ option assembly and the voltmeter. Disconnect the internal voltage sensing leads and store. Extend the remote voltage sensing leads to the load or battery observing proper polarity of connections. Connect load or battery by closing the BATTERY DISCONNECT switch or replacing the disconnect link.

l) Turn on the rectifier by placing the AC input switch to the ON position.

m) Return the FLOAT/EQUALIZE switch to the FLOAT position and readjust the FLOAT potentiometer. Turn the FLOAT/EQUALIZE switch to the EQUALIZE position and readjust the EQUALIZE potentiometer. Return the FLOAT/EQUALIZE switch to the FLOAT position.

Load Sharing Adjustment

5.11 This rectifier is equipped with a load sharing circuit which allows the rectifier to share the load proportionately with other rectifiers that can be adjusted to the same output voltage, and are equipped with negative-bus load sharing circuits. For proper load sharing, it is essential that each rectifier be adjusted to the same output voltage, using the following procedure:

a) Temporarily open the rectifier load sharing leads of all paralleled rectifiers and turn off all but one rectifier.

CAUTION

If the load demand exceeds the rating of a single rectifier, the remaining load power is supplied by the batteries, causing battery discharge.

b) With the other paralleled rectifier(s) turned off, insure that the one rectifier still operating is adjusted to the required output voltage at 100% rated load.

c) Check the load sharing voltage across TB3 terminals 2 (-) and 3 (+) to determine if it is 8 VDC. If not, adjust potentiometer R28 on circuit card RAC-A7 to obtain 8 VDC. Refer to Figure 5-1 for location.

d) Start the second rectifier to be adjusted, turn off the first rectifier, and repeat Steps b) and c) for the second rectifier. Repeat this procedure for each paralleled rectifier, one at a time, until all the rectifiers are adjusted for the same output voltage at

100% load and the load sharing voltage is 8 VDC.

e) Close the load sharing lead between all paralleled rectifiers, then restart the rectifiers. The load should now be shared proportionally by the rectifiers.

Ripple Regulator Adjustment

5.12 This adjustment potentiometer is located on circuit card RR-A11 which monitors the amount of ripple current through the DC output filter capacitors. This adjustment determines the amount of ripple current required to reduce rectifier output voltage. The ripple regulator is factory adjusted to start limiting rectifier output voltage when ripple current through the DC filter capacitors reaches 15 amperes in Model RHM100D50 and 55 amperes in Models RHM200D50 and RHM400D50. Customer adjustment of this circuit under normal operating conditions is not recommended. The only time this adjustment should be made by the customer is when a replacement RR-A11 circuit card has been installed in the rectifier. Circuit card RR-A11 is located on the rear of the front access door in Models RHM100D50 and RHM200D50 and on the rear of the front access panel on Model RHM400D50. To adjust the ripple regulator circuit card, observe the following procedure:

DANGER

Voltages capable of producing severe, perhaps fatal, electrical shock are present within the rectifier. Insure that AC and DC sources are completely disconnected before performing this procedure; otherwise, hazardous voltages will be encountered in the following procedure.

a) Turn off the rectifier by operating the AC INPUT switch to the OFF position, and disconnect battery or load from the output terminals. If remote voltage sensing leads are extended, (Ⓣ option), disconnect and insulate. Connect internal voltage sensing leads (Ⓡ option) to terminals 1(+) and 2(-) of TB3.

WARNING

Polarity of the voltage sensing leads is critical. When connecting these leads, verify connections carefully to assure correct polarity, terminals 1(+) and 2(-) on terminal board TB3.

b) Install Ⓜ option capacitor assembly A10 on circuit card RAC-A7.

c) Connect a test load and adjust the load for at least 20 amperes of load when adjusting Model RHM100D50, and for at least 60 amperes of load when adjusting Models RHM200D50 or RHM400D50.

d) Remove DC filter capacitor alarm fuse F3A and DC filter capacitor fuse F3 from their respective fuseholders.

e) Connect an AC ammeter capable of measuring either 0-20 amperes when adjusting Model RHM100D50, and 0-60 amperes when adjusting Models RHM200D50 and RHM400D50 across the fuse socket of DC filter capacitor fuse F3.

f) Disconnect the AC input at the external distribution point and disconnect any one AC input phase to the rectifier at terminal block TB1. Temporarily insulate the disconnected wire.

g) Close the external AC input disconnect device and restart the rectifier by operating the AC INPUT switch to the ON position.

h) Adjust potentiometer R3 on circuit card RR-A11 clockwise or counterclockwise as necessary until the AC ammeter connected across the F3 fuseholder indicates 15 amperes when adjusting Model RHM100D50, or 55 amperes when adjusting Models RHM200D50 or RHM400D50.

i) The adjustment procedure is now complete. Turn the rectifier off and open the external AC input distribution device. Reconnect the AC input phase

removed in Step f), remove the ammeter and Ⓜ option capacitor assembly, and replace fuses F3 and F3A in that order. Reconnect the load at output terminal block TB2, extend the remote voltage sensing leads, if desired, and rturn the rectifier to service.

6. CIRCUIT DESCRIPTION

General

6.01 This rectifier provides isolated, filtered and regulated DC power from a three-phase AC source for powering a load while charging batteries.

6.02 The description of the circuit is presented by functional blocks. Refer to Figure 6-1 for a rectifier block diagram.

AC Input Circuit

6.03 Commercial 208/240, 60 Hz, three phase AC power is applied through AC INPUT switch S1 connected to the primary of power transformer T1. Tap connections on the primary of transformer T1 permit selection of either of the two AC input voltages.

Power Supply Assembly PSA-A8

6.04 This power supply assembly provides the +12 and -12 VDC required to power the Regulator and Alarm Circuit Card RAC-A7. An additional DC output of this assembly provides an input to the current walk-in circuit.

6.05 The +12 VDC output of this assembly is derived from AC voltage of phase B secondary winding of power transformer T1. The AC voltage is applied to the power supply circuit through resistors R4 and R8, or R7 and R8 in Model RHM400D50, respectively. The AC input is rectified by diodes CR1 and CR2 and a portion of the resultant DC is applied to the current walk-in circuit of the Regulator and Alarm Circuit RAC-A7. The remainder of the DC is passed through diode CR3 to the zener regulator. Zener diode CR14, in conjunction with filter capacitor C2, provides a regulated +12 VDC output which is applied to the Regulator and Alarm Circuit RAC-A7.

6.06 The -12 VDC output of this assembly is derived from negative battery voltage. Negative battery voltage is applied to the power supply through resistor R2 or R9 in Model RHM400D50. Zener diode CR15, in conjunction with filter capacitor C1, produces the regulated -12 VDC output which is applied to the Regulator and Alarm Circuit RAC-A7.

Power Circuit

6.07 The six phase star-connected secondary of power transformer T1 feeds a six phase rectifier. Basically, the rectifier circuits consist of six power diodes and six thyristors. Each of the six rectifier circuits are identical; therefore, one is described as typical. The conduction of the thyristor is controlled by a pulse circuit on RAC-A7 which will be explained later. When the thyristor is not conducting, the output of the power transformer is supplied through the power diode only. When higher output voltage is required, a pulse fires the thyristor causing it to conduct. When the thyristor conducts, an additional winding of the power transformer is inserted into the circuit thus increasing output voltage. The amount of output voltage added is dependent upon the time the thyristor was fired in relation to the phase of the AC input voltage. The output of each rectifier phase is combined and applied to the output circuit. In the Model RHM400D50 Rectifier only, the outputs of the rectifier circuits are applied to an interphase transformer, which balances the outputs of the rectifier circuits before applying the resultant output to the filter circuit. A resistor and capacitor network across the thyristors and the power diodes reduce conducted RF interference. The DC output of the rectifier which contains appreciable amount of ripple is passed through an LC type filter which reduces the ripple to a minimum. The resulting filtered DC output power is connected through the output fuse and battery disconnect device to output terminals.

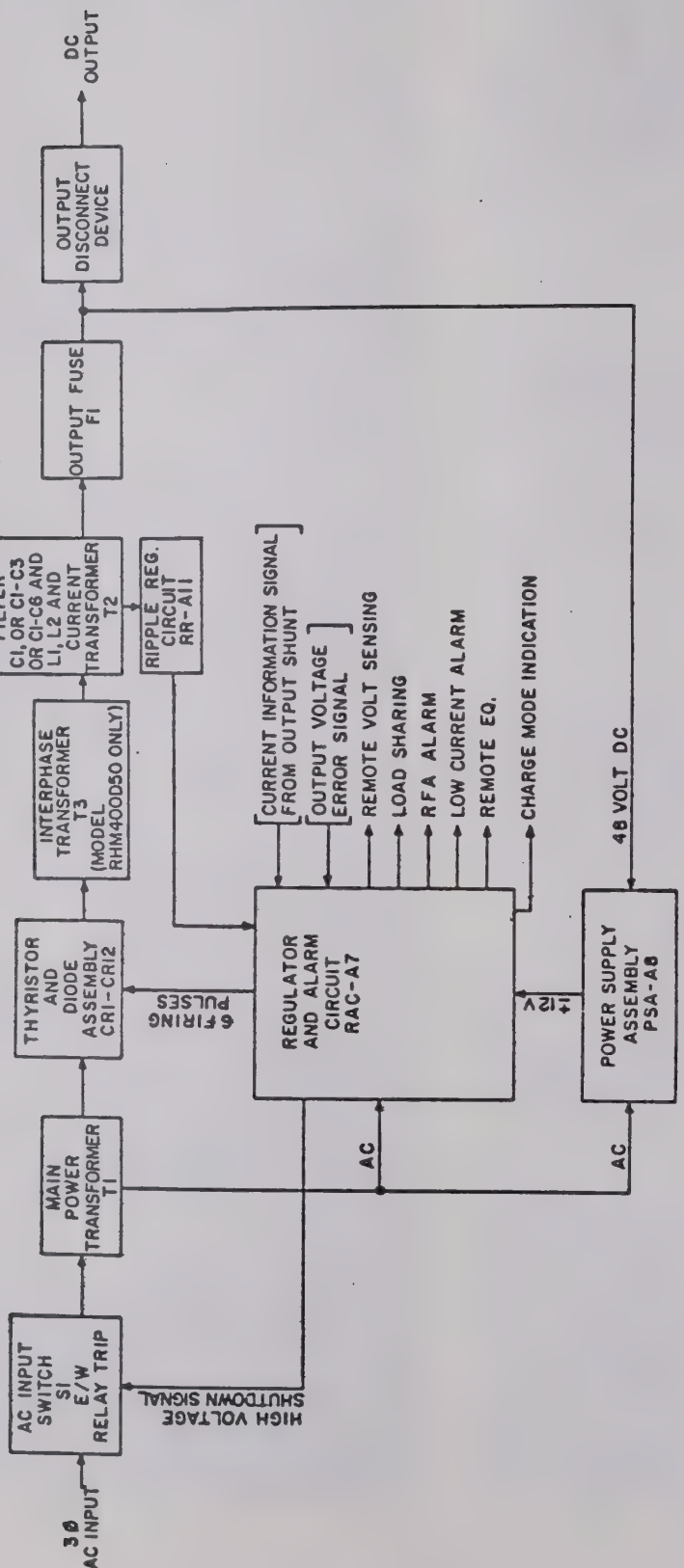


Figure 6-1. Functional Block Diagram

Voltage and Current Regulation Circuitry

6.08 During normal rectifier operation, the voltage and current regulation functions of the rectifier are controlled by circuitry on Regulator and Alarm Circuit RAC-A7. During a high output ripple condition caused by the loss of an AC input phase, the regulation of rectifier output voltage and current is partially controlled by the Ripple Regulator Circuit Card RR-A11.

Circuit card RAC-A7 utilizes integrated circuitry to perform the phase control regulation function. The regulation and phase control circuit monitors the output of the rectifier and ultimately produces a pulse which gates the thyristors in the power circuit. Depending upon the output voltage, the gate pulse is either advanced or delayed in relation to the phase of the AC input voltage to control the rectifier output. If the thyristor is gated early in the AC cycle, the output voltage increases. If the thyristor is gated later in the AC cycle, the output voltage decreases.

6.09 A current limiting circuit senses rectifier output current and provides a signal to the regulator circuit which limits output current to a preset, safe value. The regulation function is performed by three separate but interacting circuits. These circuits are the voltage reference and error detection circuit, the current sensing and current regulation circuit, and the pulse generation and phase control circuit.

Voltage Reference and Error Detection

6.10 This circuit compares the output of the rectifier with a fixed voltage and provides an error signal which represents the magnitude and direction of any difference. The negative sense voltage is applied to a resistance network consisting of resistors R8 and R10, EQUALIZE and FLOAT ADJUST potentiometers R11 and R12 respectively, resistors R13 and R74, and range potentiometer R16. Potentiometer R16 is connected to the cathode of zener reference diode CR3. The anode of CR3 is connected to common (0). Therefore, the voltage at the junction of diode CR3 and potentiometer R16 is more positive than the positive sensing lead. The resistors in the resistor network mentioned above are proportioned such that the slider of potentiometer R12 is at ground potential when the voltage on the sensing leads is at the correct regulated value. If the rectifier output voltage is too high, the voltage at the slider of potentiometer R12 becomes negative with respect to common, causing the output of amplifier A17 to go positive. If the rectifier output voltage is too low, the voltage at the slider of potentiometer R12 becomes positive with respect to common, causing the output of amplifier A17 to go negative. Diode CR1 at the output of amplifier A17 is used in conjunction with diode CR4 of the current sense circuit to provide isolation of control between the voltage and current regulating circuits. The current sensing and current regulation circuit is connected into the regulation circuit at the cathode of CR1. At this point, the voltage and current regulator circuits are connected in an OR type configuration. Whichever regulator output is more positive controls the pulse and phase control circuits. The output of this OR circuit is connected to an inverting voltage follower A18, which generates a second error signal equal in magnitude but of opposite polarity to the signal generated by A17. The positive and negative error signals thus generated by A17 and A18, are applied to the pulse generation circuits where the error signal inputs are used to generate the thyristor gate pulses.

Current Sensing and Current Regulation

6.11 This circuit senses the output current of the rectifier and changes the operation of the rectifier from voltge regulation to current regulation when the output current reaches a predetermined value. The positive output of the rectifier is passed through 50 millivolt meter shunt R16. The voltage drop across the shunt deflects the output ammeter and also provides a control signal proportional to the output current. This control signal is applied to the input of shunt amplifier A6 through resistors R21 and R26. Shunt amplifier A6 provides an output voltage to both the low current alarm and load sharing circuit as well as the current regulator circuit which limits and regulates rectifier output.

The current limit setting of the rectifier is determined by a series string of resistors connected at the output of shunt amplifier A6. These resistors include CURRENT LIMIT potentiometer R23 and resistors R17, R19, and R64.

6.12 Resistor R17 is associated with the temperature sensing and fan fail circuitry and is removed from the circuit by a shorting jumper in Models RHM100D50 and RHM200D50. In Model RHM400D50 which is equipped with cooling fans, resistor R17 is normally shorted out by closed contacts of relay K1 which are connected at J4 pins 11 and 12. When the temperature of the rectifier heat sinks exceeds +85° C (+185° F) or if air flow through the cabinet ceases, resistor R17 is inserted into the circuit to decrease the rectifier output current. Refer to the description of the temperature sensing circuit for details.

6.13 Resistor R64 is connected to the cathode of zener diode CR3. When the rectifier is supplying less current than the current limit setting of potentiometer R23, the current limit circuit performs no regulation function. When output current exceeds the level set by potentiometer R23, the voltage at the junction of potentiometer R23 and resistor A15 (3-4) causes amplifier A5 to generate an error signal. The current limit error signal output of current control amplifier A5 is coupled to the voltage control circuit through CR4. This signal causes the rectifier to operate in the current regulation mode.

Pulse Generation Phase Control Circuits

6.14 This circuit card contains three identical pulse circuits, one for each AC phase. Each pulse circuit generates the firing pulse used to gate two thyristors in each phase. The pulse circuits control the phaseback angle of the thyristors in response to a signal from the voltage regulator described previously. The firing circuit for each thyristor consists of a driver transistor which is controlled by two comparators, a reference comparator and a synchronizing comparator. The reference comparator receives an error signal from the regulator circuit which is compared to an integrated sine wave derived from the power transformer T1 secondary winding. The reference comparator utilizes this information to determine when to turn on the driver transistor. The synchronizing comparator provides clamping action to prevent firing of the thyristor when the thyristor is reverse biased.

6.15 The control of phaseback angle is based on a comparison of a cosine reference voltage, which leads the line by 90°, against a signal from the voltage regulator circuit. Since the circuit card contains three identical phase control circuits, the operation of the one may be taken as typical. The cosine voltage is generated by an active integrator consisting of an operational amplifier A4, resistors A9 (6-9), A10 (6-9), and capacitor C11. Resistors A9 (5-10) and A10 (5-10) and capacitor C14 balance the input to amplifier A4. The cosine voltage at the output of A4 is applied to the inputs of two comparators of A3. Since the voltages on the power thyristors are 180° out of phase, it follows that their corresponding firing pulses must be 180° out of phase. To develop two signals with the same phaseback angle but 180° out of phase with each other, the cosine voltage is applied to the non-inverting input of one compartor of A3, and to the inverting input of the second compartor of A3. At this point, the positive and negative error signals generated by the regulator circuit are applied to the pulse generation circuit. These error signals are equal in magnitude but opposite in polarity. The cosine voltage applied to the non-inverting input of comparator A3 at pin 5 is compared to the positive error signal applied to the comparator at pin 4. When the cosine voltage at pin 5 becomes more positive than the reference signal at pin 4, the output signal of the comparator at pin 2 unclamps the base of driver transistor A8, causing transistor conduction and generation of a firing pulse which is applied to the respective thyristor. At the same time, the positive going cosine voltage applied to comparator A3 at inverting input 6 is compared to the negative error signal applied to the comparator non-inverting input 7. With the non-inverting input more positive during the entire half cycle, the output of the comparator at pin 1 remains clamped to its negative

power supply voltage which is sufficient to bias its respective driver transistor A8 off. During the negative half cycle, the first driver transistor is cut off and the second driver transistor conducts, generating a firing pulse which is applied to its respective thyristor.

6.16 The synchronizing comparators of A3 receive a signal from a secondary winding of power transformer T1. This signal is voltage divided by resistors A12 (4-13) and A16 (3-4) and applied to the synchronizing comparators where the signal is referenced to common. The sampled voltage is applied to the inputs of the synchronizing comparators which function as open collector type comparators. The comparator inputs are paralleled but opposite in polarity. The opposite polarity is achieved by applying the sampled voltage to the non-inverting input of the first comparator at pin 9 and applying the sampled voltage to the inverting input of the second comparator at pin 10. During a positive half cycle, the output of one comparator is clamped to the negative supply and the output of the second comparator is allowed to float. The two comparator outputs are applied to the base of their respective driver transistor A8. In this way, the comparators are used to clamp the base of the respective driver transistor to assure no firing pulses are applied to the thyristors when the thyristors are reverse biased. Transistor Q2, zener diode CR19, diodes CR6 and CR7 and associated components are used in single phase rectifiers only, and have no function in this application.

Current Walk-in Circuit

6.17 A current walk-in circuit on Regulator and Alarm Circuit card RAC-A7 prevents the rapid application of initial load. A timer circuit provides an approximate 8 second delay from the time the rectifier is started until full rated output current is available to the load. The current walk-in feature of the rectifier is achieved by suppressing the current regulator reference voltage and allowing it to increase at a fixed rate. When the rectifier is turned off, the walk-in circuit is reset to time 0. The walk-in circuit consists of amplifiers A4 and A5 and associated components. Amplifier A5 transistor Q9, zener diode CR21 and associated components form a walk-in reset circuit which assures that the walk-in circuit resets to zero in the event of momentary AC power failures.

6.18 When the rectifier is started, a positive DC output from Power Supply PSA-A8 is applied to the cathode of zener diode CR21. This voltage causes transistor Q9 to conduct. Conduction of transistor Q9 provides 0 volts to the inverting input of amplifier A5 (1, 2, 3) which produces a positive output of the amplifier. This positive voltage is applied to voltage follower A5 (12, 13, 14). The voltage follower charges capacitor C6 which is connected to the input of a second voltage follower A4, the output of which follows the capacitor voltage directly. This voltage is diode coupled through CR14 to the current limiting voltage divider circuit to limit the output current. The output current gradually increases as capacitor C6 charges. Once capacitor C6 charges to a level higher than the reference voltage, it is decoupled by diode CR14. The time required to charge capacitor C6 to the reference voltage will be the same as the time required for the walk-in.

6.19 When the rectifier is turned off or the commercial AC input fails momentarily, the positive DC input from Power Supply PSA-A8 is removed from CR21. This biases transistor Q9 into cutoff; subsequently, amplifier A5 (1, 2, 3) produces a 0 volt output which is applied to voltage follower A5 (12, 13, 14). When the 0 volt signal is applied, the output of the voltage follower seeks common to balance its input. In so doing, capacitor C6 is discharged through diode CR2 into the amplifier, resetting the walk-in circuit.

Negative Load Sharing Circuit

6.20 As mentioned in the current sensing and current regulation description previously given, shunt amplifier A6 provides a voltage which is dependent on rectifier output current. This voltage is applied to amplifier A7 at non-inverting input pin 10. Amplifier A7, transistor Q1, resistors R9, R20, R77, R29 and load sharing adjust potentiometer R28 comprise the load sharing circuit. A negative load sharing lead at J2 pin 16 of the circuit

card is connected at the junction of resistors R9 and R20. This load sharing lead is connected to the similar load sharing lead on the other paralleled rectifiers. The output of amplifier A7 at pin 8 causes transistor Q1 to conduct. Conduction of Q1 inserts resistor R29 and load sharing adjustment potentiometer R28 into a voltage divider circuit which also includes resistors R20 and R9. This voltage divider is connected across negative rectifier output and common. As mentioned previously, the load sharing lead is connected at the junction of resistors R9 and R20. If a paralleled rectifier is supplying more or less than its proportional share of the load, the voltage at the load sharing terminal, and thus the voltage across resistor R9, is decreased or increased. This change in voltage across R9 is applied to the voltage regulator circuit at the junction of resistors R8 and R10. By altering the voltage in the voltage regulator circuit, the rectifier output voltage is increased or decreased which increases or decreases rectifier output current.

Alarm Circuits

6.21 The Regulator and Alarm Circuit card RAC-A7 contains the following alarm circuits: low current alarm, high and low voltage alarm, and an overvoltage shutdown alarm. The operation of each is described below.

a) Low Current Alarm: As mentioned previously in the current sensing and current regulation description, shunt amplifier A6 provides a voltage dependent on rectifier output current. This voltage is applied to amplifier A5 at non-inverting input pin 10. The inverting input at pin 9 is connected to the slider of the low current alarm adjustment potentiometer R50 through resistor R51. Potentiometer R50 and resistor R51 provide an offset adjustment for amplifier A5 which compensates for circuit variations. The output of the amplifier at pin 8 is proportional to rectifier output current and is applied to the inverting input of amplifier A7 at pin 6. The non-inverting input to amplifier A7 at pin 5 is connected to a reference voltage circuit consisting of resistors A13 (8-9), A13 (6-11) and R81. When the rectifier output current decreases below the low current alarm value, the voltage at pin 6 of amplifier A7 crosses the reference voltage at pin 5 of the amplifier. When this happens, a negative output signal from amplifier A7 at pin 7 is applied to the base of transistor Q6 through resistor R48. This signal drives transistor Q6 into conduction, supplying common to the anode of LOW CURRENT ALARM LED3 which then illuminates. Positive voltage is also applied to the base of transistor Q7 through resistor A14 (5-6). This voltage drives Q7 to conduction, thereby applying negative voltage to the base of transistor Q8 which is biased into cutoff. When Q8 is cut off, the coil of alarm relay K1 is deenergized, causing K1 to release. Contacts of relay K1 are used to actuate external alarms, if connected. During normal operation with rectifier output current within limits, the base of Q8 is connected to common through resistor R43. This causes Q8 to conduct, providing negative voltage to relay K1 which energizes the coil.

b) High and Low Voltage Alarm: Since the operation of the high and low voltage alarms is similar, the operation of the high voltage alarm circuit described below may be taken as typical. This circuit compares the rectifier output voltage with a constant reference voltage developed on the circuit card. A sense voltage from the negative rectifier output is applied to a voltage divider consisting of resistors R36, R40 and potentiometer R39. Adjustment of potentiometer R39 determines the value at which a high voltage alarm is given. The voltage at the junction of resistors R36 and R40 is applied to amplifier A7 at non-inverting input pin 12. This signal is compared to a constant reference voltage applied to the amplifier at inverting input pin 13. When rectifier output voltage exceeds the setting of potentiometer R39, a negative signal

from the amplifier at pin 14 is applied to the base of transistor Q4 through resistor R42. This signal drives transistor Q4 into conduction, supplying common to the anode of HIGH VOLTAGE ALARM LED1 which then illuminates. Positive voltage is also applied to the base of transistor Q10 through resistor A14 (1-2) and jumpered pins 2A to 6A of J5. This voltage drives Q10 into conduction, supplying negative voltage to the base of transistor Q11 which is biased into cutoff. When Q11 is cut off, the coil of alarm relay K1 on Alarm Interface Assembly AI-A9 is deenergized causing relay K1 to release. Contacts of relay K1 provide open and closed circuits at TB3 for actuation of external rectifier failure alarms, if connected.

c) Overvoltage Shutdown: This circuit monitors the rectifier output voltage and initiates shutdown if the output voltage exceeds a preset adjustable value. A voltage divider consisting of resistors R85, R33, R31 and potentiometer R32 is connected between the rectifier negative output and common. The setting of potentiometer R32 determines the voltage value at which the rectifier is shutdown. The base of transistor Q3 is connected at the junction of resistors R31 and R33 through zener diode CR5. When the rectifier output voltage exceeds the preset high voltage limit, transistor Q3 conducts, which provides a gate signal to thyristor CR13 through diode CR17. Thyristor CR13 conducts which energizes the trip coil of input switch S1, resulting in rectifier shutdown.

Ripple Regulator Circuit Card RR-A11

6.22 This circuit card continuously monitors the ripple current through the rectifier DC output filter capacitors. During normal rectifier operation, the ripple current is within the adjustable limits set by the ripple regulator circuit card and no output signal is provided. However, if one AC input phase is lost or another failure occurs which results in a high output ripple condition exceeding the ripple current setting of circuit card RR-A11, the ripple regulator provides a positive output signal. This signal is applied to the regulation circuitry of Regulator and Alarm Circuit RAC-A7 causing a subsequent reduction in rectifier output voltage. The ripple regulator reduces rectifier output voltage until the ripple current through the filter capacitor is reduced to normal limits.

6.23 Current transformer T2 senses the ripple current through the DC filter capacitor and applies a voltage to ripple regulator circuit card RR-A11 at pins 1 and 2. This input is rectified by diodes CR1 through CR4 and filtered by resistor R2 and capacitor C1. The resulting voltage is applied through resistor R5 to the non-inverting input of comparator A1. The variable input at the non-inverting input of A1 is compared to a reference voltage applied at the inverting input of A1. The reference voltage is derived from potentiometer R3 and resistor R4, and is adjustable depending upon the setting of potentiometer R3. This reference input determines the value of ripple current at which the ripple regulator circuit provides a signal to the regulation circuitry on circuit card RAC-A7. When the ripple current through the capacitor exceeds the ripple current setting of potentiometer R3, comparator A1 provies a positive output signal through diode CR5 to the regulator and alarm circuit.

6.24 This positive signal is applied to the inverting input of voltage follower A18 on RAC-A7 which generates a negative error signal of equal amplitude but opposite polarity. The resulting positive and negative error signals are then applied to the pulse generation circuitry previously described.

Fuse Alarm Circuit

6.25 A fuse alarm circuit provides a visual alarm indication if fuse F1 or F2 opens, or if fuses F3 or F4 open in Model RHM400D50. When any main fuse opens, the associated alarm fuse F1A, F3A, or F4A opens, and negative battery is applied through resistor R18, R17, R19, or R21 respectively. Light emitting diode FUSE ALARM illuminates providing a local fuse alarm indication. Fail-

ure of DC output fuse F1 disables the rectifier, activating external alarms if connected.

Temperature Sensing Circuit
(Model RHM400D50 Rectifier only)

6.26 The Model RHM400D50 Rectifier is equipped with cooling fans and fan failure and temperature sensors. The fan fail sensors are located on circuit cards FFC-A12 and FFC-A13 which are mounted on the top of the heat sinks, while the temperature sensors M3 and M4 are mounted on the bottom of the heat sinks. The fan fail circuits continuously monitor the presense of air flow through the cabinet, while temperature sensors M3 and M4 continuously monitor the temperature of the heat sinks. If the air flow through the cabinet ceases or the temperature of the heat sink reaches +85° C (+185° F), relay K1 opens a set of contacts which reduce rectifier output current to 66% of full rated load and activate an external rectifier fail alarm, if connected.

6.27 Fan fail circuit cards FFC-A12 and FFC-A13 and temperature sensors M3 and M4 are connected in series with the coil of relay K1. During normal operation, the temperature sensors and fan fail monitors are closed which energizes the coil of K1. Contacts of relay K1, energized, provide closed circuits between J4 pins 11 to 12 and J2 pin 14 to J5 pin 11 of circuit card RAC-A7. The closed circuit across J4 pins 11 to 12 bypasses resistor R17 in the current limiting voltage divider circuit of RAC-A7, while the closed circuit across J2-14 to J5-11 supplies voltage to hold rectifier fail relay K1 on alarm interface assembly AI-A9 energized. This inhibits the external rectifier fail alarms. With resistor R17 bypassed in the voltage divider, the current limiting circuit is adjusted by potentiometer R23 to provide full rated output current. During a fan failure or overtemperature condition, relay K1 is deenergized, removing the bypass across resistor R17 in the current limit circuit and opening the coil circuit of relay K1 on AI-A9. Addition of resistor R17 into the current limit voltage divider alters the voltage in the divider which results in reducing the current limit setting of potentiometer R23. Insertion of resistor R17 results in limiting output current at approximately 66% of full load. This prevents damage from overheating the rectifier during a fan failure. Opening the coil path of relay K1 on AI-A9 causes the relay to release, activating an external rectifier fail alarm circuit, if connected.

7. TROUBLESHOOTING

General

7.01 Before attempting to troubleshoot this rectifier, it must be determined that a failure has occurred in the rectifier. Since various rectifier alarms sense battery voltage, an incorrect battery voltage could reflect back to the rectifier as an alarm condition. Erroneous alarm conditions due to incorrect battery voltage may be caused by interconnection with other equipment. Some examples of interconnecting equipment which could cause incorrect battery voltage are given below. Eliminate any interconnected equipment as a trouble cause before proceeding.

a) When used in a power system, certain failures in DC-DC Converters and/or DC-AC Inverters may affect battery voltage and subsequently cause alarm indicators on the rectifier to illuminate.

b) When used with other parallel connected rectifiers, a failure in one rectifier may cause alarm indicators on other rectifiers to illuminate.

7.02 Once trouble has been isolated to the rectifier, various visual and operational checks should be made to eliminate obvious failure causes. Before starting any troubleshooting, check the following:

DANGER

Voltages capable of producing severe, perhaps fatal, electrical shock are present throughout all portions of the rectifier cabinet. Disconnect AC and DC sources before performing any troubleshooting procedures.

a) Check to be sure AC input power is available to the rectifier.

b) Check all fuses in the rectifier to assure that no fuses are open.

Use of the Troubleshooting Chart

a) The flow chart which follows helps isolate malfunctions by giving the technician a yes or no option. Once the technician has arrived at block "See Causes", he should refer to Para. 7.03 which contains the list of Most Probable Causes.

b) When the trouble is isolated to a printed circuit card, the card should be replaced. No attempt should be made to troubleshoot or repair the circuit cards.

c) If the trouble is suspected to be caused by an out of adjustment condition, the adjustment setting should be checked using the appropriate adjustment procedure.

d) Certain trouble conditions may require no specific check procedures (e.g., open fuses), therefore, no additional information is given. If a specific procedure is required to check certain trouble conditions, a repair procedure is contained in the rectifier repair procedures section of these troubleshooting instructions.

7.03 Most Probable Cause

1) Failed regulator circuit on RAC-A7 - see Procedure 4.

2) Failed thyristor - see Procedure 5, 6.

3) Failed alarm circuit on RAC-A7.

4) Failed power diode - see Procedure 2.

5) Failed auxiliary ± 12V power supply PS-A8.

6) Failed power transformer T1.

7) Failed output capacitor - see Procedure 1.

8) Failed output inductor.

9) Misadjusted FLOAT/EQUALIZE potentiometers. (Refer to Paragraphs 5.04 and 5.05.)

10) Misadjusted current limit potentiometer. (Refer to Para. 5.06.)

11) Misadjusted low current alarm potentiometer. (Refer to Para. 5.10.)

12) Misadjusted high voltage shutdown potentiometer. (Refer to Para. 5.10.)

13) Loss of a single AC input phase.

14) Misadjusted load sharing potentiometer. (Refer to Para. 5.11.)

15) Misadjusted high voltage alarm potentiometer. (Refer to Para. 5.08.)

16) Misadjusted low voltage alarm potentiometer. (Refer to Para. 5.07.)

17) Open output fuse F1 - see causes 1, 6, 9, 12.

18) Open reference leads - see Procedure 3.

19) Insufficient load.

20) Open resistor R1, R3, R5, R6, R7, or R9.

21) Input voltage not suited for tap setting.

22) Open load sharing lead.

23) Faulty Ripple Regulator Circuit card RR-A11.

24) Failed SCR Fire Circuit card(s) A1-A6.

25) Open filter capacitor fuse.

26) Open sense fuse F2.

Rectifier Repair Procedures

7.04 The repair procedures which follow are made with the unit under test disconnected from any power source, unless specifically stated otherwise in the test procedure.

7.05 Failed components may sometimes be found by a visual inspection of the rectifier circuitry. Obvious signs of trouble such as loose connections, overheated, discolored, or burned components, or burned and melted wire insulation should be corrected and thoroughly checked before proceeding with more detailed test and repair procedures.

7.06 Since it may be possible to locate a failed component without disconnecting it from the circuit, check each suspected component in the unit before disconnecting any leads. If the trouble cannot be determined in this manner, disconnect the leads and recheck the component. Replace any failed components.

7.07 As an identification aid, semiconductor device outlines are provided so that identification of various semiconductor terminations may easily be made.

DANGER

Do not connect grounded test equipment to any live component. This could result in damage to the equipment under test. At the same time, a personnel shock haz ard exists since the chassis and case of ungrounded test equipment can become energized to a potentially dangerous voltage level above ground. Servicing personnel must exercise caution that they do not contact the test equipment chassis or case and some grounded object at the same time, when the test equipment is connected to an operating rectifier.

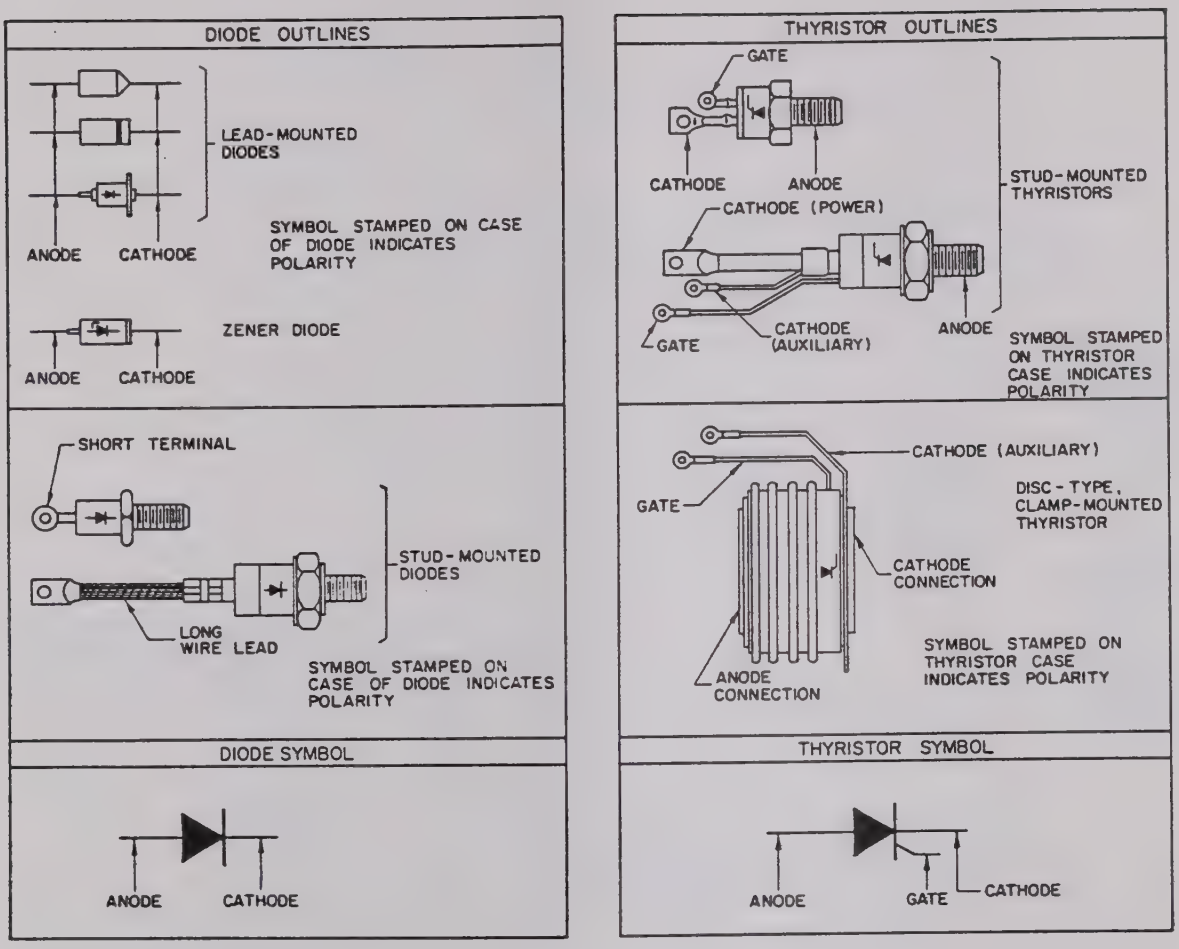
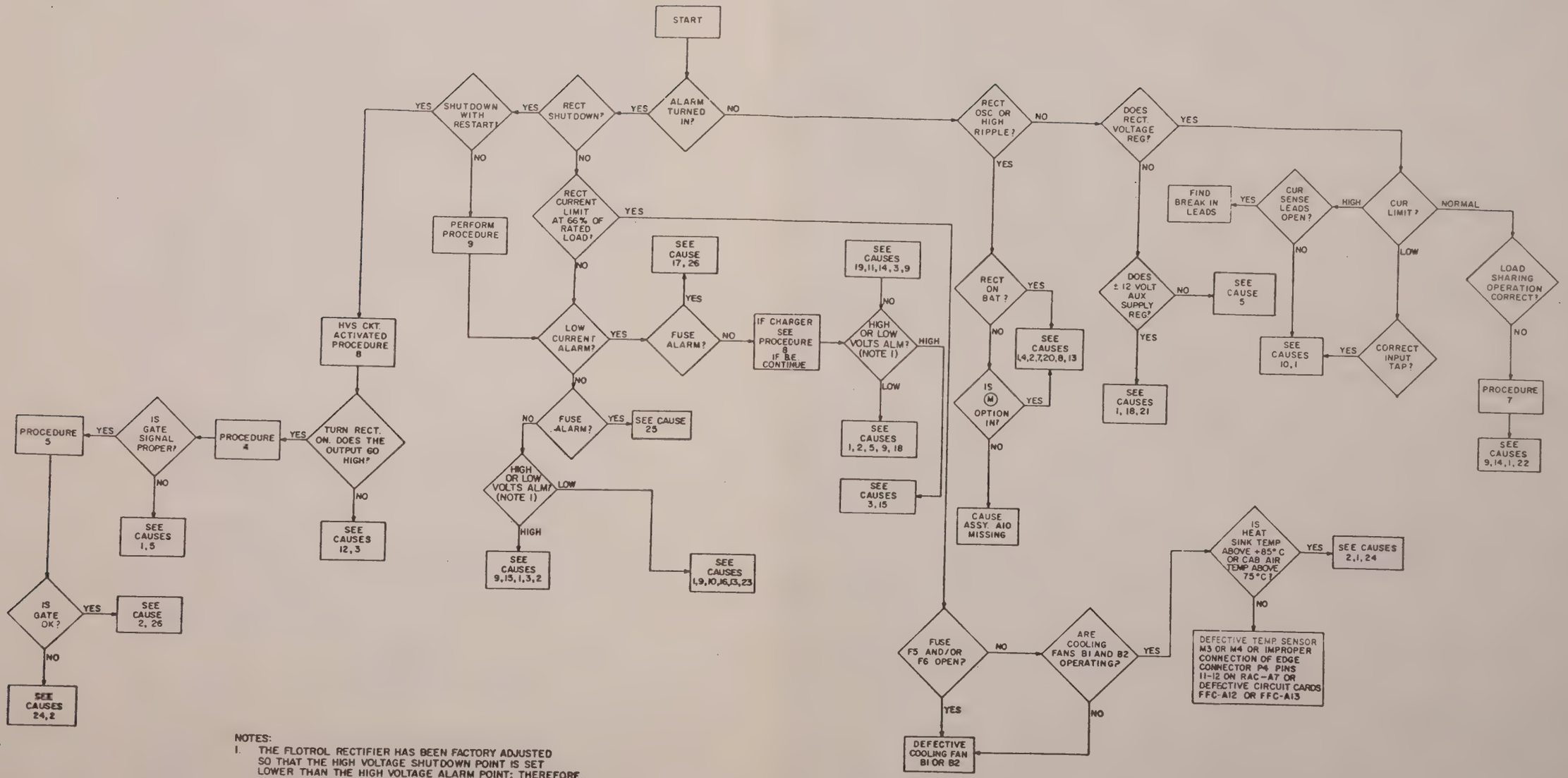


Figure 7-1. Semiconductor Identification Outlines

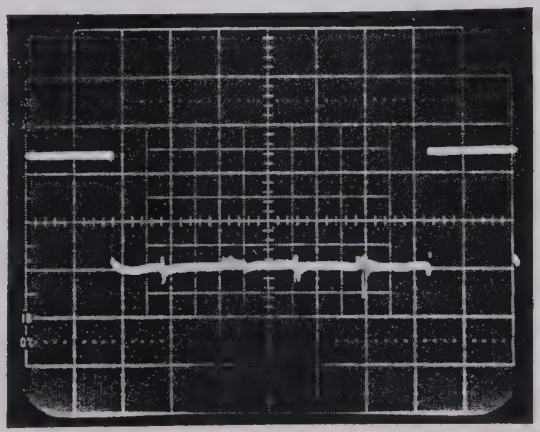

START
ALARM TURNED IN?
RECT SHUTDOWN?
SHUTDOWN WITH RESTART?
PERFORM PROCEDURE 9
RECT CURRENT LIMIT AT 66% OF RATED LOAD?
SEE CAUSE 17, 26
LOW CURRENT ALARM?
FUSE ALARM?
IF CHARGER SEE PROCEDURE 8 IF BE CONTINUE
SEE CAUSES 19,11,14,3,9
HIGH OR LOW VOLTS ALM? (NOTE 1)
SEE CAUSES 1,2,5,9,18
SEE CAUSES 3,15
FUSE ALARM?
SEE CAUSE 25
HIGH OR LOW VOLTS ALM? (NOTE 1)
SEE CAUSES 9,15,1,3,2
SEE CAUSES 1,9,10,16,13,23
HVS CKT. ACTIVATED PROCEDURE 8
TURN RECT. ON. DOES THE OUTPUT GO HIGH?
SEE CAUSES 12,3
PROCEDURE 4
IS GATE SIGNAL PROPER?
SEE CAUSES 1,5
PROCEDURE 5
IS GATE OK?
SEE CAUSE 2, 26
SEE CAUSES 24,2
RECT OSC OR HIGH RIPPLE?
RECT ON BAT?
SEE CAUSES 14,2,7,20,8,13
IS (M) OPTION IN?
CAUSE ASSY. A10 MISSING
FUSE F5 AND/OR F6 OPEN?
DEFECTIVE COOLING FAN B1 OR B2
ARE COOLING FANS B1 AND B2 OPERATING?
DOES RECT. VOLTAGE REG?
DOES ± 12 VOLT AUX SUPPLY REG?
SEE CAUSE 5
SEE CAUSES 1, 18, 21
FIND BREAK IN LEADS
CUR SENSE LEADS OPEN?
SEE CAUSES 10, 1
CUR LIMIT?
CORRECT INPUT TAP?
LOAD SHARING OPERATION CORRECT?
PROCEDURE 7
SEE CAUSES 9, 14, 1, 22
IS HEAT SINK TEMP ABOVE +85° C OR CAB AIR TEMP ABOVE 75°C?
SEE CAUSES 2, 1, 24
DEFECTIVE TEMP. SENSOR M3 OR M4 OR IMPROPER CONNECTION OF EDGE CONNECTOR P4 PINS 11-12 ON RAC-A7 OR DEFECTIVE CIRCUIT CARDS FFC-A12 OR FFC-A13
YES
NO
HIGH
LOW
NORMAL

NOTES:

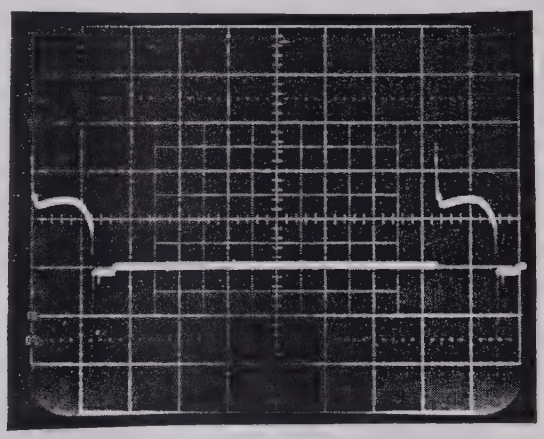
1. THE FLOTROL RECTIFIER HAS BEEN FACTORY ADJUSTED SO THAT THE HIGH VOLTAGE SHUTDOWN POINT IS SET LOWER THAN THE HIGH VOLTAGE ALARM POINT; THEREFORE, A HIGH VOLTAGE ALARM IS ONLY POSSIBLE IF THE HIGH VOLTAGE ALARM POINT HAS BEEN CUSTOMER ADJUSTED FOR A VALUE LOWER THAN THE HIGH VOLTAGE SHUTDOWN SETTING.

Figure 7-2. Rectifier Fault Isolation Chart

REPAIR PROCEDURE NO.	CHECK/REMEDY
1	Disconnect the capacitor(s) to be tested from the circuit. Use a capacitance bridge or capacitance tester to check any capacitor suspected of failure; however, if such a test instrument is unavailable, an ohmmeter may be used. Connect the negative ohmmeter lead to the positive terminal of the capacitor, and the positive ohmmeter lead to the negative terminal of the capacitor. Initially, the indicated resistance will be low, gradually increasing as the capacitor charges. Initial high resistance indicates an open capacitor, whereas continued low resistance indicates a leaky or shorted capacitor. Replace the capacitor(s) as required.
2	To check a diode, connect an ohmmeter across the diode leads, then reverse the ohmmeter connections. The ohmmeter should indicate high resistance in one direction and low resistance in the opposite direction. Low resistance or high resistance in both directions is an indication that the diode may have failed. If a diode failure is suspected, disconnect one of the leads and recheck the resistances. Replace the diode if it has failed.
3	Remove input power to the rectifier by operating the AC input switch to the OFF position. **DANGER** AC power is still present within the rectifier cabinet at terminal board TB1 and at switch S1. Open the rectifier front access cover and connect a DC voltmeter (or multimeter) to terminal board TB3. Terminal number 1 is positive (+), and terminal number 2 is negative (-). The voltmeter should indicate battery voltage, (approximately 48 VDC). If battery voltage is not present, this indicates that the reference leads are open between the rectifier and the battery. Correct as required.
4	Remove AC input power to the rectifier by operating the AC input switch to the OFF position. **DANGER** Hazardous AC and DC voltages are still present throughout the rectifier cabinet. This procedure checks for proper gate pulse outputs of circuit card RAC-A7. This procedure should be performed to check the gate signal to each of the six thyristors. If the gate signal applied to any of the six thyristors is incorrect, circuit card RAC-A7 should be replaced. To check for proper gate signals from circuit card RAC-A7, follow the procedure below.

REPAIR PROCEDURE NO.	CHECK/REMEDY
4 Cont'd)	**DANGER** Do not connect grounded test equipment to any live component. This could result in damage to the equipment under test. At the same time, a personnel shock hazard exists since the chassis and case of ungrounded test equipment can become energized to a potentially dangerous voltage level above ground. Servicing personnel must exercise caution that they do not contact the test equipment chassis or case and some grounded object at the same time when the test equipment is connected to an operating rectifier. 1) Open the front access cover of the Model RHM100D50 or RHM200D50 Rectifiers, or remove the lower front panel of the Model RHM400D50 Rectifier. Locate the SCR firing circuit cards A1-A6 (Part No. 4334-016) located on the heat sinks near the bottom of the rectifier. 2) Disconnect plug P1 from the SCR firing circuit card being checked and connect an oscilloscope between terminals 4 and 5 of plug P1 to observe firing pulses from card RAC-A7. Connect the common oscilloscope lead to terminal 5 (cathode) for each thyristor. 3) After all test connections have been made, insure that all test leads are insulated (or separated) from each other and from surrounding exposed connection points. 4) Start the rectifier by operating the AC input switch to the ON position. 5) Observe on the oscilloscope the thyristor firing pulses. A signal similar to that shown below should appear across terminals 4 and 5 for each thyristor. If the signal is absent or irregular, replace card RAC-A7. 

REPAIR PROCEDURE NO.	CHECK/REMEDY
4	The waveshape, as shown, is approximately 12 volts peak-to-peak amplitude with a variable time duration depending upon the voltage of the AC input line, the output voltage setting, and the load placed on the rectifier. The waveshape shown was taken with oscilloscope adjusted for a sweep time of 2 milliseconds/division, and with the rectifier operating from 208 VAC input and adjusted for an output of 52 VDC at 50% load.
5	Remove AC input power to the rectifier by operating the AC input switch to the OFF position. **DANGER** Hazardous AC and DC voltages are still present throughout the rectifier cabinet. This procedure checks for proper gate pulse outputs of SCR firing circuit cards A1 through A6 (Part No. 4334-016). If the gate signal output of any of circuit cards A1 through A6 is incorrect, the circuit card should be replaced. To check for proper gate signals at the thyristor, follow the procedure below. **WARNING** Do not connect grounded test equipment to any live component. This could result in damage to the equipment under test. At the same time, a personnel shock hazard exists since the chassis and case of ungrounded test equipment can become energized to a potentially dangerous voltage level above ground. Servicing personnel must exercise caution that they do not contact the test equipment chassis or case and some grounded object at the same time when the test equipment is connected to an operating rectifier. 1) Open the front access cover of the Model RHM100D50 or RHM200D50 Rectifiers, or remove the lower front panel of the Model RHM400D50 Rectifier. Locate the SCR firing circuit cards A1-A6 (Part No. 4334-016) located on the heat sinks near the bottom of the rectifier. 2) Connect an oscilloscope between terminals 6 and 7 of the SCR Fire Circuit card (Part No. 4334-016) to be checked. Connect the common oscilloscope lead to terminal 6 (cathode) for each thyristor. 3) After all test connections have been made, insure that all test leads are insulated (or separated) from each other and from surrounding exposed connection points.

REPAIR PROCEDURE NO.	CHECK/REMEDY
5 (Cont'd)	4) Start the rectifier by operating the AC input switch to the ON switch. 5) Observe on the oscilloscope the thyristor firing pulses. A signal similar to that shown below should appear across terminals 6 and 7 for each thyristor. If the signal is absent or irregular, replace the SCR card, Part No. 4334-016.  The waveshape, as shown, is approximately 1 1/2 volts peak-to-peak amplitude with a variable time duration depending upon the voltage of the AC input line, the output voltage setting and the load placed on the rectifier. The waveshape shown was taken with the oscilloscope adjusted for a sweep time of 2 milliseconds/division, and with the rectifier operating from 208 VAC input and adjusted for an output of 52 VDC at 50% load.
6	Disconnect the cathode and gate leads of any thyristor to be checked. The cathode and gate leads may be disconnected at a terminal board, or the leads themselves may be disconnected from the circuit. If the thyristor has short, lug-type terminals, circuit wiring may be disconnected at these terminals. If the rectifier utilizes the clamp mounted disc-type thyristors, do not attempt to loosen the clamping device in order to remove the thyristor from its heat sink. Disconnect power circuit wiring at the heat sink, and remove the firing circuit (gate and cathode) leads at their terminal board. A thyristor tester should be used to check for an anode-to-cathode open or short. If such a tester is not available, the thyristor can be checked by the use of an ohmmeter. To check for an anode-to-cathode short, measure the resistance from anode-to-cathode; a low resistance

<table>
<tr><th>REPAIR PROCEDURE NO.</th><th>CHECK/REMEDY</th></tr>
<tr><td>6 (Cont'd)</td><td>indicates an anode-to-cathode short. To check for an open or shorted thyristor gate, measure the resistance of the gate-to-cathode in both directions. A reading of zero ohms in both directions indicates a shorted thyristor. A reading of infinity in both directions indicates an open thyristor. Replace the thyristor as required.</td></tr>
<tr><td>7</td><td>To determine if the load sharing circuitry is operating correctly, connect a DC voltmeter (or multimeter) to the output of the load sharing circuit card, terminals number 2 (-) and number 3 (+) of TB3. Since this circuit provides a linear output voltage with respect to rectifier output current, the circuit operation may be checked under several load conditions as shown in the table below:
<table>
<tr><th>Percentage of Rated Rectifier Output Current</th><th>Load Sharing Output Voltage (VDC)</th></tr>
<tr><td>12.5</td><td>1</td></tr>
<tr><td>25</td><td>2</td></tr>
<tr><td>37.5</td><td>3</td></tr>
<tr><td>50</td><td>4</td></tr>
<tr><td>62.5</td><td>5</td></tr>
<tr><td>75</td><td>6</td></tr>
<tr><td>87.5</td><td>7</td></tr>
<tr><td>100</td><td>8</td></tr>
</table>
If paralleled rectifiers with similar load sharing circuits installed do not proportionately share a load, insure that all output voltage controls are adjusted so that all rectifier outputs are at the same voltage level. Similarly, all load sharing circuits must be correctly adjusted. Refer to Section 5. ADJUSTMENTS for correct procedures for adjustment of output voltage, and adjustment of load sharing circuitry.

If, after attempting the required adjustments the load sharing circuit output voltage is missing or irregular, replace the circuit card RAC-A7.</td></tr>
<tr><td>8</td><td>Operate the BATTERY DISCONNECT switch to the OFF position or remove the BATTERY DISCONNECT link. Transfer the sense leads to internal at TB2, and install the M option assembly on circuit card RAC-A7.</td></tr>
<tr><td>9</td><td>Check all rectifier functions, look for possible bad connections and check CR14 on A8.</td></tr>
</table>

8. MODEL DATA

8.01 Refer to the Power Data Sheet for information concerning the input and output ratings, operating limits, dimensions, recommended input and output lead sizes, fusing and terminal lug capacity for the rectifiers covered by these instructions.

LORAIN PRODUCTS

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(216) 288-1122/TWX. 810-426-2130 (LORAIN PROD)/TLX. 98-0505 (LORN PROD LORN)

In Canada —
Reliance Telecommunication Products Ltd., 122 Edward St., St. Thomas, Ont.
TEL. 519-631-0780/TWX. 610-356-6703 (LORAIN PRODCAN)

In Mexico —
Productos Lorain de Mexico, S.A. de C.V., Apartado Postal 77001
TEL. 576-82-77/TLX./01774308 (1774308 LORME)

RELIANCE
COMM/TEC

ADDENDUM

In addition to the customer adjustable selective high voltage shutdown circuit described in the instruction manual, this FLOTROL® Rectifier also contains a second non-adjustable high voltage shutdown circuit. This second high voltage shutdown circuit is designed to shutdown the rectifier in the event of a failure which inhibits the customer adjustable selective high voltage shutdown circuit. This circuit assures that rectifier output voltage will not increase to a level that could cause damage to the rectifier or the load. The circuit is proportioned so that the non-adjustable high voltage shutdown point always remains 2 volts above the adjustable setting for 50 volt rectifiers and 1 volt above the adjustable setting for 25 volt rectifiers.

The non-adjustable high voltage shutdown point is determined by resistor R88 (© option) on the regulator and alarm printed circuit card. If resistor R88 is removed, the non-adjustable high voltage shutdown circuit is removed and the selective high voltage shutdown feature of the rectifier is inhibited.

LORAIN PRODUCTS
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PARTS LIST

REF DESIG	DESCRIPTION	L.P.C. PART NO.	QTY PER MODEL RHM100D50	SPARE PARTS QTY LEVEL MINIMUM	ON-SITE	DEPOT
C1	22,000MFD, 75VDC	2731-382	1	-	1	1
C8-C10	.1X.1 277VAC	2717-110	3	-	1	1
C11-C13	.22MFD,1000VDC	2713-619	3	-	1	1
C14	100MFD 75UDC	2731-149	1	-	1	1
C16,18,20, 22,24,26	1.0 MFD 600VDC	2715-275	6	-	1	1
C27	0.47 MFD 100VDC	2713-152	1	-	1	1
C28,30	2 MFD 100VDC	2713-198	2	-	1	1
C31	100 MFD 200VDC	2715-297	1	-	1	1
CR14	ZENER 12V	2836-216	1	-	1	1
CR15	ZENER 12 V	2836-217	1	-	1	1
CR1,3,5, 7,9,11	THYRISTORS	2864-041	6	-	2	3
CR2,4,6, 8,10,12	DIODES	2813-724	6	-	2	3
CR13,16	DIODE	2812-330	2	-	2	3
DS1	LED ASSY (RED)	4257-022	1			
F1	150AMP 250V	2485-384	1	1	1	1
F2	GMT 3 AMP	2486-109	1	1	1	1
F1A, F3A	GMT 1/4 AMP	2486-102	2	2	2	2
F3	20 AMP	2483-511	1	1	1	1
L1, L2	INDUCTOR DC	4412-048	2	-	-	1
M1	0-150 A AMMETER	2924-867	1	-	-	1
M2	0-75V VOLTMETER	2944-864	1	-	-	1
R1, R20, R3-R9	100 OHM 25 WATT	2656-511	9	-	-	1
R16	150 AMP SHUNT	2982-745	1	-	-	1
R17-R19	4.7K OHM 3 WATT	2651-347	3	-	-	1
R2	100 OHM 50 WATT	2656-610	1	-	-	1
A1-A6	SCR FIRE ASS'Y	4334-016	6	-	1	1
A7	REG. & ALM. ASS'Y.	4865-087	1	-	1	1
A8	POWER SUPPLY	4865-622	1	-	1	1
A9	ALARM INTERFACE	4338-362	1	-	1	1
A10 (M)	OFF BAT. CAP. ASS'Y.	4251-014	1	-	1	1
A11	RIPPLE REG ASS'Y	4865-644	1	-	1	1
S1	100AMP 480VAC	2513-933	1	-	-	1
S2	225 AMP 240VAC	2513-865	1	-	-	1
T1	TRANSFORMER	4568-562	1	-	-	1
T2	TRANSFORMER	4425-513	1	-	-	1
RV1-3	VARISTOR	2676-341	3	-	1	1

* INDICATES THE PART OR ASSEMBLY IS LISTED MORE THAN ONCE USE THE RECOMMENDED SPARE QUANTITY WHERE THE ITEM FIRST APPEARS

• FOR REPLACEMENT ORDER 4832-038

TABLE A

3 Φ INPUT VOLTAGE	USE TB1'S	MODEL	INPUT VOLTS	T1 CONNECTIONS WIRE (D)	WIRE (E)	WIRE (F)
208	L1-L2-L3	RHM100D50	208	6A-7B	6B-7C	6C-7A
240	L1-L2-L3		240	6A-8B	6B-8C	6C-8A

NOTES

1 EQUIPMENT SUPPLIED WITH INTERNAL VOLTAGE SENSE LEADS BETWEEN TB3 REMOTE SENSE TERMINALS (1) AND (2) AND OUTPUT TERMINALS. REMOVE THESE LEADS WHEN EXTERNAL SENSE LEADS ARE USED

2 STORE INTERNAL VOLTAGE SENSE LEAD HERE

3 D-INDICATES LEAD IS A JUMPER

4 (R) -(STANDARD) INTERNAL VOLTAGE SENSE

5 (T) -REMOTE VOLTAGE SENSE OPTION.

6 (X) -REMOTE EQUALIZE OPTION.

7 (M) -REQUIRED FOR BATTERY-LESS OPERATION

8 -VOLTMETER SWITCH DEFEAT- THIS JUMPER IS REQUIRED IN ORDER TO READ BATTERY VOLTAGE WHEN S1 IS IN OFF POSITION.

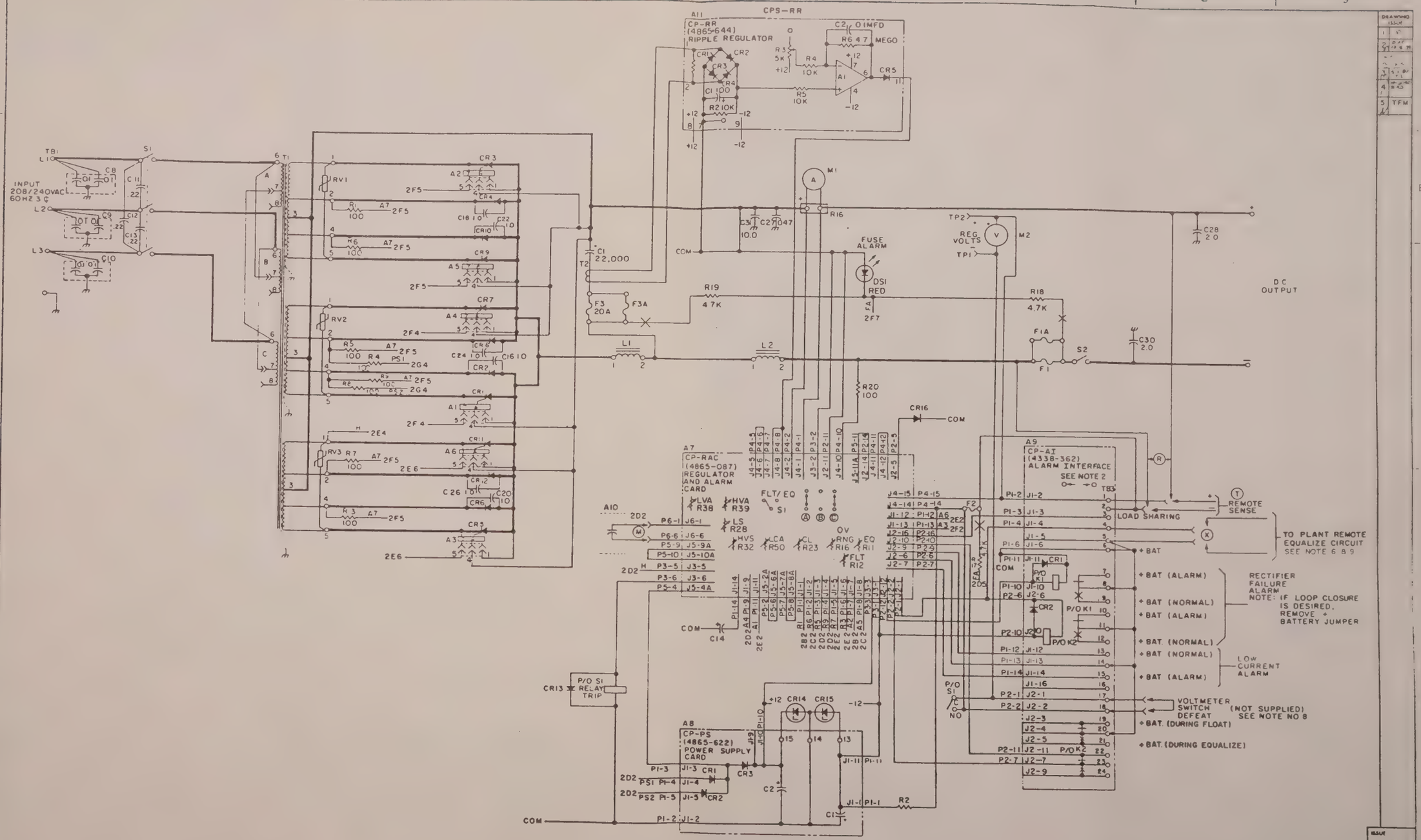
9 -A LOOP CLOSURE IS REQUIRED TO PLACE RECTIFIER INTO EQUALIZE. (+) BATTERY IS SUPPLIED AT TB3-21 DURING EQUALIZE

REVISIONS

1 M	NEW, WAS 181-7080 ISS 1		
2 M	183 7012	12-5-79	D.A.C.
	F2 WAS 1-1/3 AMP, (2486-107)		
2 RM	T1 CONNECTIONS CORRECTED 6C-8A WAS 6C-8B		
3 M	1837126	5-1-80	T.I.
	S2 WAS 2513-861 BP		
4	1837341	10-21-80	D.A.C.
	SD5454-017 ADDED		
4 RM	3-6-81	D.A.C.	
	NOTE 8 CORRECTED		
5	1837833	8-24-82	T.F.M.
	A8 WAS 4865-648.		

181-7080	DESIGN J. RADER	ISS 5	
SCHEMATIC DIAGRAM FOR RHM 100D50	DRAWN BY J.TUTTLE	DATE 2-6-79	
	CHECKED BY	DATE	
	CHECKED BY	DATE 10/22/82	
	APPROVED BY	DATE 11-19-82	
	RATING STANDARD		
LORAIN PRODUCTS CORPORATION LORAIN, OHIO	DWG SIZE D	SD5454-017 SD5454-010	
		SHEET 1 OF 2	

PRINTED IN U.S.A.



SCHEMATIC DIAGRAM FOR RHM 100D50	SD5454-017 SD5454-010
LORAIN PRODUCTS CORPORATION — SIZE D	SHEET 2 — PRINTED IN U.S.A.

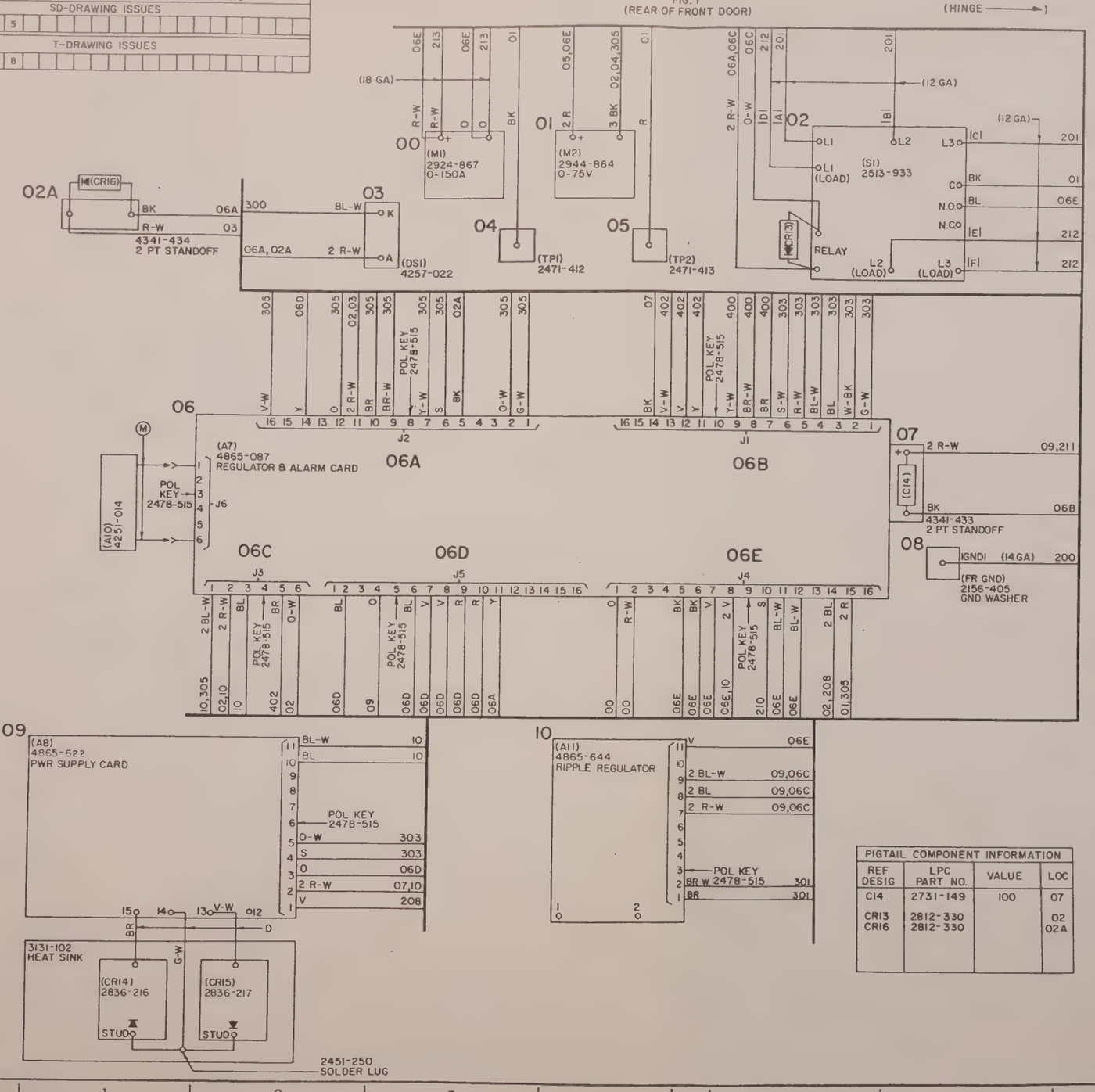
ISSUE 5

SD-DRAWING ISSUES AND T-DRAWING ISSUES AS FOLLOWS:

SD-DRAWING ISSUES: 1 2 3 4 4 4 4 5

T-DRAWING ISSUES: 1 2 3 4 5 6 7 8

FIG. 1
(REAR OF FRONT DOOR)



MANUFACTURING NOTES:

1. ALL WIRING TO BE 22 GA UNLESS OTHERWISE SPECIFIED
2. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS.
3. D- INDICATES LEAD IS A JUMPER
4. BI-TERMINAL NEAREST MOUNTING SURFACE
5. |A|, |B|, ETC. - INDICATES WIRE LABELS
6. PT- LEADS WHICH ARE PART OF COMPONENTS OR SUBASSEMBLIES.
7. HI- WIRES RUN THROUGH CORRESPONDINGLY DESIGNATED HOLES.
8. —●— SPLICE

PIGTAIL COMPONENT INFORMATION

REF DESIG	LPC PART NO.	VALUE	LOC
C14	2731-149	100	07
CR13	2812-330		02
CR16	2812-330		02A

REVISIONS

1	M	NEW BP NOV 5 1979	
2	M	1837012 12-5-79 D.A.C. F2 WAS 1-1/3 AMP (2486-107)	
3	M	1837126 5-1-80 T1. S2 WAS 2513-861 BP MAY 1 1980	
4		1837341 10-21-80 D.A.C. T5454-017 ADDED BP NOV 12 1980	
5	M	1837392 11-26-80 J.R. "G" (16 GA) WIRE ADDED TO P1 AND P2 SOCKETS BP DEC 1 1980	
6	M	1837455 2-17-81 J.R. WIRING ON F3A & F1A CHGD, & T1 (6) WIRING CORRECTED BP FEB 18 1981	
7	M	1837565 8-15-81 J.R. SOLDER LUG QTY CORRECTED AT LOC. 213 AND 402 BP SEP 17 1982	
8	M	1837833 9-15-82 J.R. A8 WAS 4865-648 BP SEP 17 1982	

181-7080

WIRING DIAGRAM FOR MODEL RHM1000D50

DESIGN	A. MARCUCCI	ISS. 8
DRAWN BY	J. REESE	DATE 3-9-79
CHECKED BY	A. MARCUCCI	DATE 3-23-79
CHECKED BY		DATE 10-30-79
APPROVED BY		DATE 10-31-79

RATING: STANDARD

T-5454-017
T-5454-010

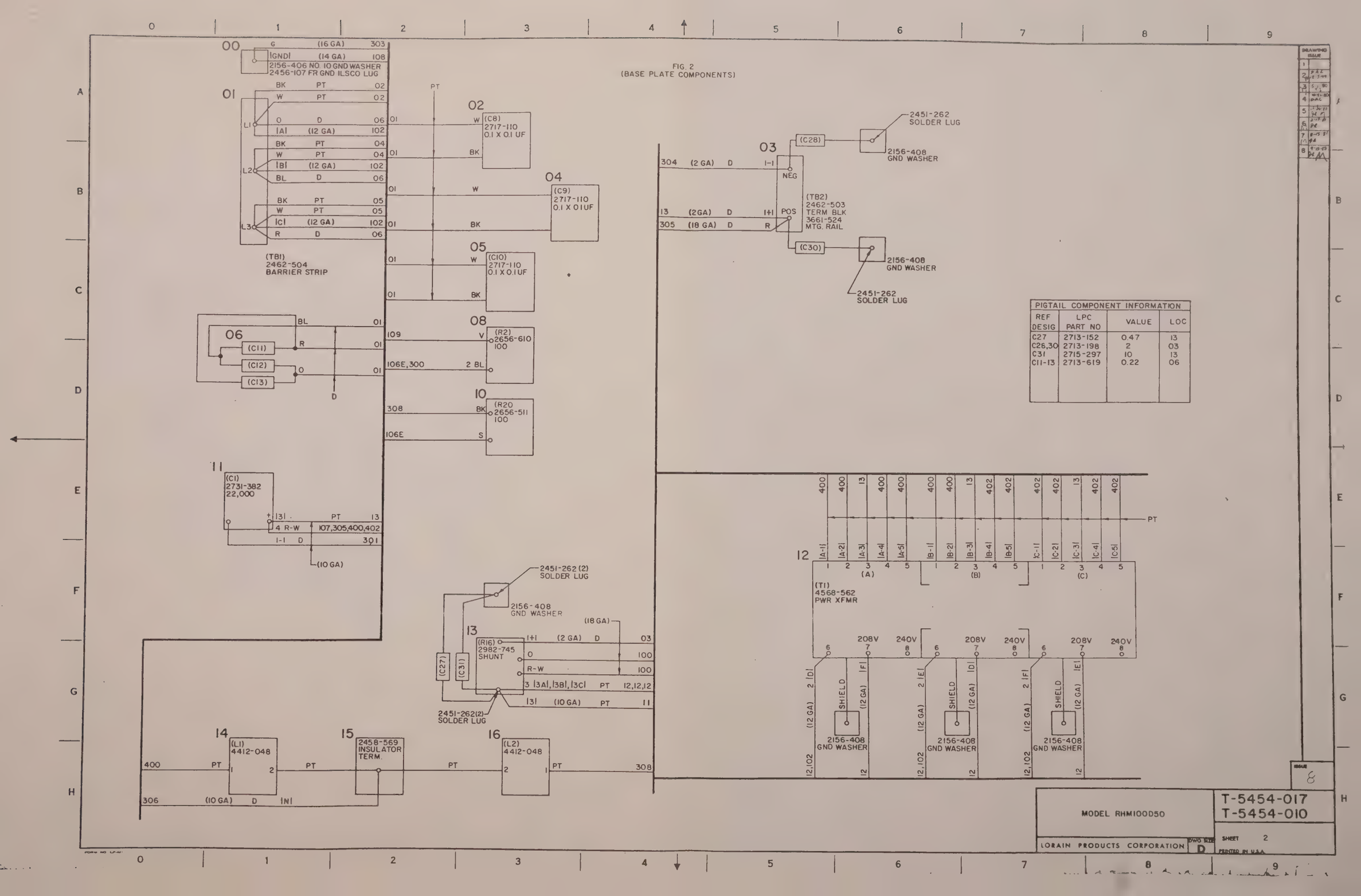
LORAIN PRODUCTS CORPORATION
LORAIN, OHIO
LORAIN PRODUCTS (CANADA) LTD., ST. THOMAS, ONTARIO

DWG SIZE: D

SHEET 1 OF 4

PRINTED IN U.S.A.

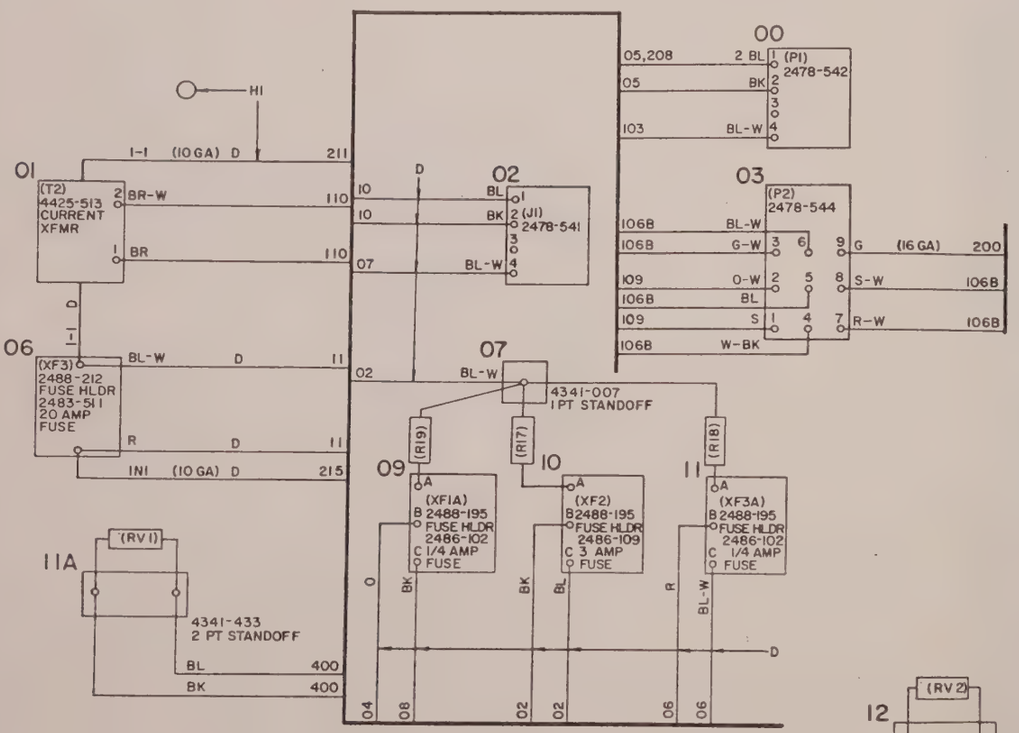
FIG. 2
(BASE PLATE COMPONENTS)



MODEL RHM100D50	T-5454-017 T-5454-010
LORAIN PRODUCTS CORPORATION DWG SIZE D	SHEET 2 PRINTED IN U.S.A.

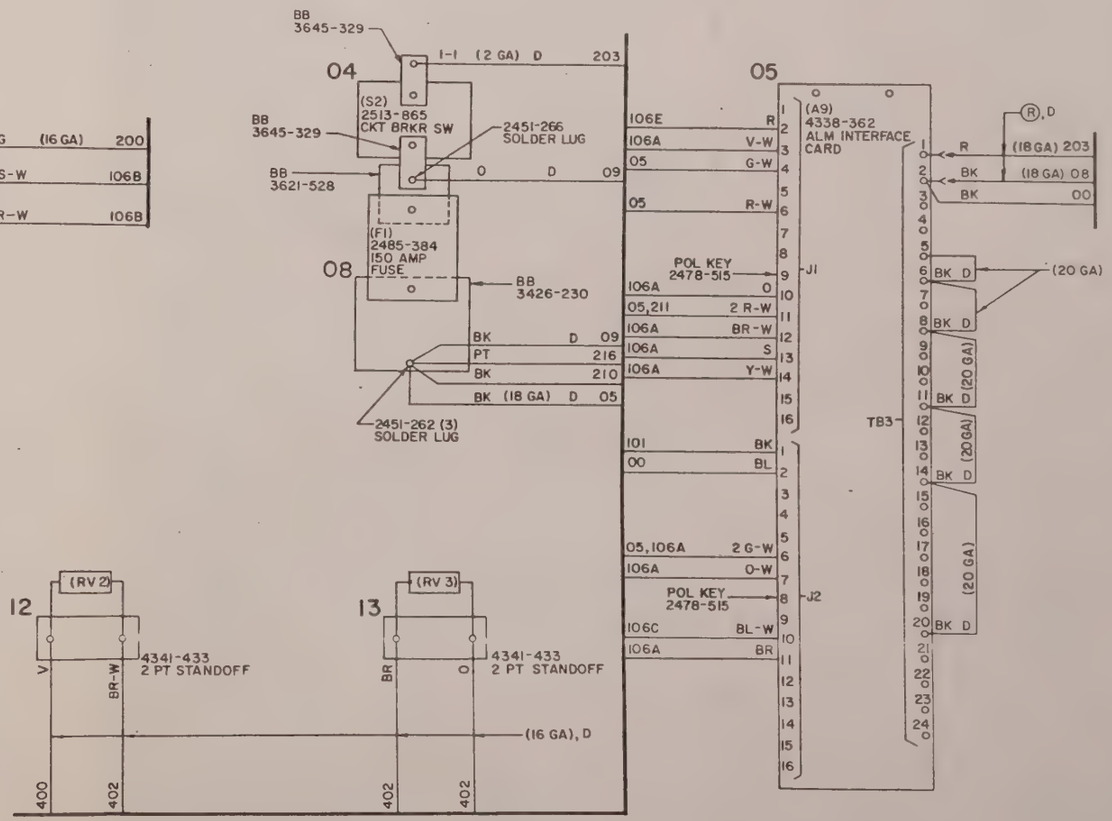
ISSUE 8

FIG. 3
(FUSE MTG PANEL)



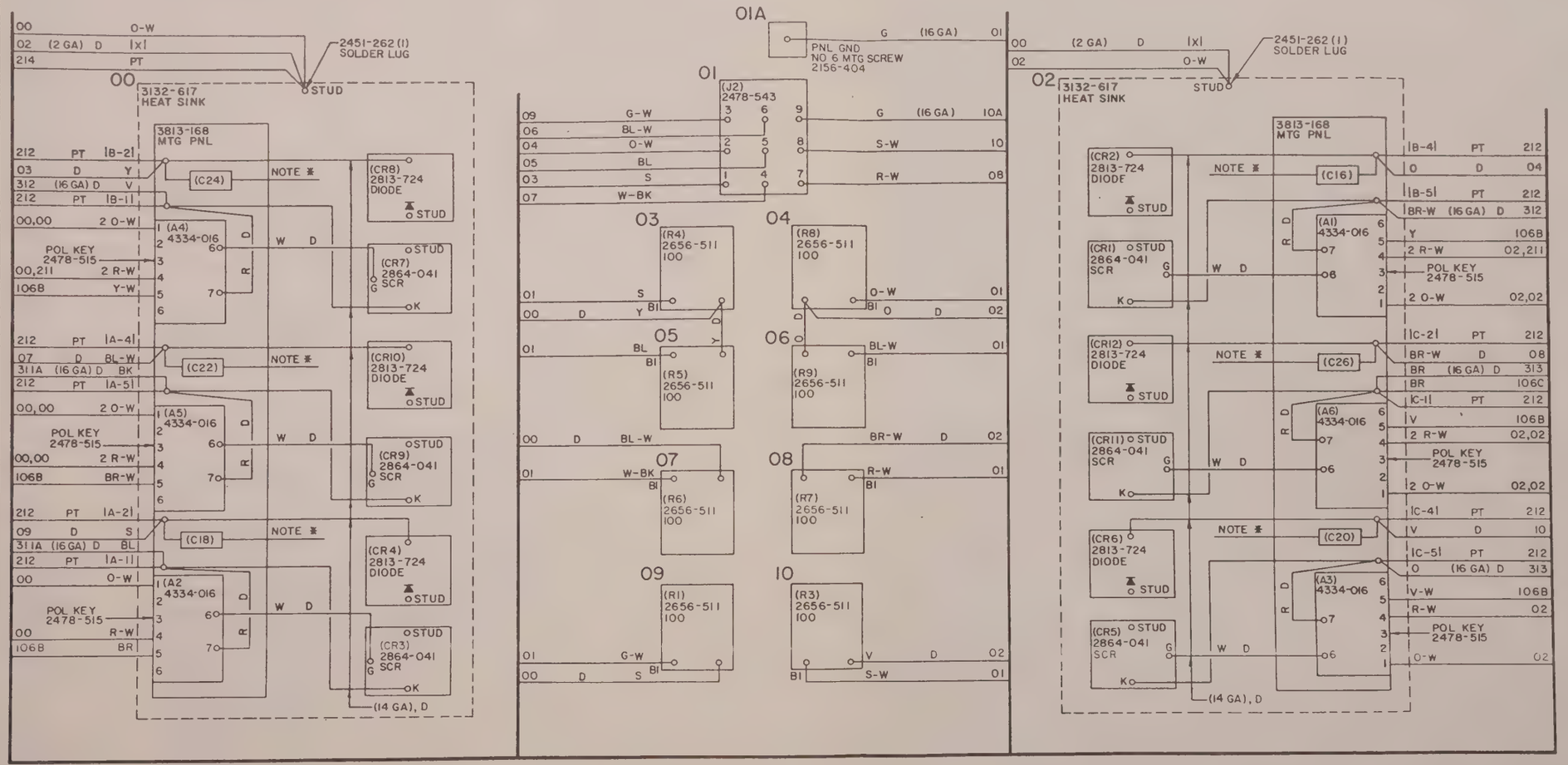
PIGTAIL COMPONENT INFORMATION			
REF DESIG	LPC PART NO.	VALUE	LOC
RI7	2651-347	4700	10
RI8	2651-347	4700	11
RI9	2651-347	4700	09
RV 1	2676-341	—	11A
RV 2	2676-341	—	12
RV 3	2676-341	—	13

FIG. 4
(SI BREAKER & ALARM INTERFACE MTG BRKT)



MODEL RHM100D50	T-5454-017 T-5454-010
LORAIN PRODUCTS CORPORATION	DWG SIZE D
	SHEET 3
	PRINTED IN U.S.A.

FIG. 5
(HEAT SINK ASSY)



PIGTAIL COMPONENT INFORMATION			
REF DESIG	LPC PART NO.	VALUE	LOC
C16,20,26	2715-275	1	02
C24,22,18	2715-275	1	00

NOTE: * INSTALL 1/4 FASTON LUG (2453-664) ON CAP PIGTAIL, THEN CONNECT THEM TO GND CLIP (G)(2457-762) ON SIDE OF HEAT SINK FIN.

MODEL RHM100D50	T-5454-017 T-5454-010
LORAIN PRODUCTS CORPORATION	SHEET 4
	PRINTED IN U.S.A.

COMPONENT LIST

CAPACITOR

DESIG	CODE	
C1	(2731-112)	22UF, 50V DC, ELECT.
(2)C4,10	(2713-224)	0.033UF, 200V DC
C5	(2713-132)	0.1 UF, 100V DC
(2)C7,8	(2713-127)	0.047UF, 100V DC
C9	(2715-123)	1.5UF, 100V DC
(8)C11-18	(2713-246)	0.33UF, 200V DC
(2)C19,21	(2713-118)	0.01UF, 100V DC
C20	(2715-274)	1.0UF, 200V DC
(6)C22,25,26,33,36,37	(2724-137)	4700PF, 500V DC
C23	(2724-125)	220PF, 500V DC
C24	(2713-221)	0.022UF, 100V DC
(6)C27-32	(2724-139)	1000PF, 1000V DC
C35	(2713-152)	0.47UF, 100V DC
(4)C2,3,6,34	(2737-139)	22UF, 35V

DIODE

DESIG	CODE	
(11)CR1,2,4,8-10,14-18	(2811-101)	
(2)CR3,11	(2835-325)	6.2V, 0.4W, ZENER
CR5	(2835-543)	9.1V, 1W, ZENER
(3)CR6,7,12	(2812-310)	
CR13	(2861-079)	
(2)CR19,20	(2836-212)	12V, 1W, ZENER
CR21	(2834-525)	4.7V, 4W, ZENER
(2)LED1,2	(2818-124)	
LED3	(2818-131)	
LED4	(2818-141)	

INTEGRATED CIRCUIT

DESIG	CODE	
(3)A1,2,3	(2871-205)	QUAD COMPARATOR
(3)A4,5,7	(2871-115)	QUAD OP-AMP
A6	(2871-119)	OP-AMP
A8	(2875-401)	TRANSISTOR ARRAY
A9	(2881-214)	RESISTOR ARRAY, 75K, 1Φ — FOR 24V MODELS
A9	(2881-211)	RESISTOR ARRAY, 100K, 3Φ — FOR 48V MODELS
A9	(2881-212)	RESISTOR ARRAY, 150K, 1Φ — FOR 48V MODELS
A10	(2881-212)	RESISTOR ARRAY
A11	(2881-209)	RESISTOR ARRAY
(2)A12,13	(2881-213)	RESISTOR ARRAY
A14	(2881-206)	RESISTOR ARRAY
A15	(2881-208)	RESISTOR ARRAY
A16	(2881-207)	RESISTOR ARRAY
(2)A17,18	(2871-103)	OP-AMP
A19	(2881-218)	RESISTOR ARRAY

RELAY

DESIG	CODE
K1	(2543-405)

RESISTOR

DESIG	CODE	
R1	(2635-632)	1.43K, 1W, 1%
R2	(2635-556)	143 OHM, 1W, 1%
(2)R3,4	(2635-717)	100K, 1W, .1%
R5	(2635-703)	51.1K, 1W, 1%
R6	(2615-357)	8.2MEGO, 1/2W
R7	(2615-303)	47K, 1/2W
R8	(2615-223)	22 OHM, 1/2W
(2)R9,83	(2615-255)	470 OHM, 1/2W
R10	(2635-682)	16.2K, 1W, 1%
(3)R11,12,23	(2675-118)	5K, 1/2W, POT.
(3)R13,64,74	(2635-639)	2050 OHM, 1W, 1%
R14	(2615-335)	1 MEGO , 1/2W
(2)R15,53	(2635-610)	511 OHM, 1W, 1%
(3)R20,32,39	(2675-111)	500 OHM, 1/2W, POT.
R17	(2635-659)	5110 OHM, 1W, 1%
R18	(2635-744)	332K, 1W, 1%
R19	(2635-653)	3320 OHM, 1W, 1%
R20	(2635-563)	182 OHM, 1W, 1%
(3)R21,26,36	(2635-668)	8060 OHM, 1W, 1%
(2)R22,27	(2635-795)	1.47 MEGO, 1W, 1%
R24	(2615-271)	2.2K, 1/2W
R25	(2615-343)	2.2 MEGO, 1/2W
R29	(2615-247)	220 OHM, 1/2W
R30	(2615-273)	2.7K, 1/2W
R31	(2635-621)	665 OHM, 1W, 1%
R67	(2635-655)	3.92K, 1W, 1%
R34	(2615-269)	1.8K, 1/2W
(5)R35,57,58,59,63	(2615-263)	1K, 1/2W
R36	(2675-114)	2K, 1/2W, POT.
(2)R40,77	(2635-622)	825 OHM, 1W, 1%
(2)R41,45	(2615-319)	220K OHM, 1/2W
(4)R42,46,48,61	(2615-279)	4.7K, 1/2W
(3)R43,44,82	(2615-257)	560 OHM, 1/2W
R49	(2635-693)	27.4K, 1W, 1%
R50	(2675-120)	10K, 1/2W, POT.
R51	(2635-737)	255K, 1W, 1%
(2)R52,62	(2615-299)	33K, 1/2W
(2)R47,86	(2635-673)	10K, 1W, 1%
(3)R54,55,68	(2635-624)	1.0K, 1W, 1%
R37	(2635-623)	909 OHM, 1W, 1%
R60	(2615-275)	3.3K, 1/2W
(2)R65,69	(2635-633)	1.47K, 1W, 1%
R66	(2635-665)	6.81K, 1W, 1%
R70	(2615-311)	100K, 1/2W
R71	(2615-289)	12K, 1/2W
R72	(2635-702)	47.5 K, 1W, 1%
(2)R73,76	(2615-287)	10K, 1/2W
R16	(2675-113)	1K, 1/2 W, POT.
R75	(2635-501)	10, 1W, 1%

RESISTORS

DESIG	CODE	
R56	(2635-696)	33.2K, 1W, 1%
R78	(2635-666)	7150 OHM, 1W, 1%
R80	(2635-632)	1.43K, 1W, 1%
R81	(2635-627)	1.1K, 1W, 1%
R84	(2635-626)	1.13K, 1W, 1%
(2)R33,85	(2635-638)	1.96K, 1W, 1%
R88	(2634-662)	18.2 K, 1/4W, 1%

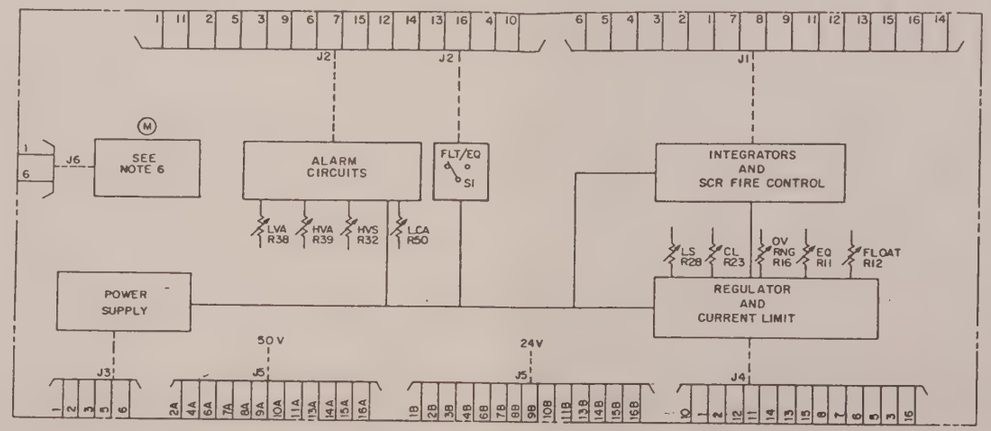
SWITCH

DESIG.	CODE
S1	(2513-453)

TRANSISTOR

DESIG	CODE
Q1	(2843-102)
Q2	(2843-099)
(3)Q4-6	(2843-110)
(4)Q7,8,10,11	(2841-038)
Q9	(2841-100)
Q3	(2843-103)

SYMBOL



NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS; VALUES PRECEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS.
2. CODES WITHIN PARENTHESES, AS (2737-139) REPRESENT LPC PART NUMBERS.
3. (A) JUMPER IS REMOVED WHEN 4865-087 IS USED WITH A FORCED AIR COOLED RECTIFIER.
4. (B) JUMPER (STANDARD) IS FOR CIRCUIT FLEXABILITY.
5. (C) RESISTOR (STANDARD) IS FOR SELECTIVE HIGH VOLTAGE SHUTDOWN (REMOVAL WILL DEFEAT SELECTIVE HV).
6. (M) OFF BATTERY CAPACITOR ASSEMBLY OPTION. (4251-014)

MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4865-087
P.W. BOARD	3158-545
CONNECTOR ON FRAME	NONE
FF FIX. NO. 6787-502	

REVISIONS

LTR	DESCRIPTION	DATE
	NEW	
	1 RM POTS. & SI ADDED TO SYMBOL	
	2 1836817 7-16-79 S.M.G. R14, R16, R75, C3, C34 CHANGED.	
	3 183-7320 2-4-81 J.R. C1,2,3,6,34 WERE 2737-139	
	4 1837527 5-18-81 J.R. C2, C3, C34 WERE 2731-112	
	5 1837573 7-10-81 D.A.C. C6 WAS 2731-112	
	5 RM 11-5-81 J.R. R DESIG. UP DATED ON SYMBOL	
	183 7755 3-2-82 D.A.C.	
	(C) OPTION CHANGED TO RESISTOR	

CIRCUIT DESCRIPTION

THIS CIRCUIT CONTAINS THE REGULATOR AND ALARM CIRCUITRY TO PROVIDE ALL REGULATOR AND ALARM FUNCTIONS FOR ALL 1Φ AND 3Φ RECTIFIERS.

THE REGULATOR CONTAINS VOLTAGE REGULATION CAPABILITY AND CURRENT LIMIT CIRCUITRY.

THE ALARMS CONSIST OF: (A) HIGH VOLTAGE ALARM (B) LOW VOLTAGE ALARM. (C) LOW CURRENT ALARM AND (D) HIGH VOLTAGE SHUTDOWN.

THE VOLTAGE RANGES OF THE ALARMS AND REGULATOR ARE SELECTED WITH AN EXTERNAL PROGRAM PLUG (J5) AND A SELECTED RESISTOR NETWORK A9. TERMINALS OF J5A ARE USED WITH 24V RECTIFIERS.

184-3422

REGULATOR AND ALARM CIRCUIT

DESIGN	J. GIANCATERINO	ECL 6
DRAWN BY	J. REESE	DATE 1-31-77
CHECKED BY		DATE 3-8-77
CHECKED BY		DATE 5-17-77
APPROVED BY		DATE 5-19-77
RATING	STANDARD	

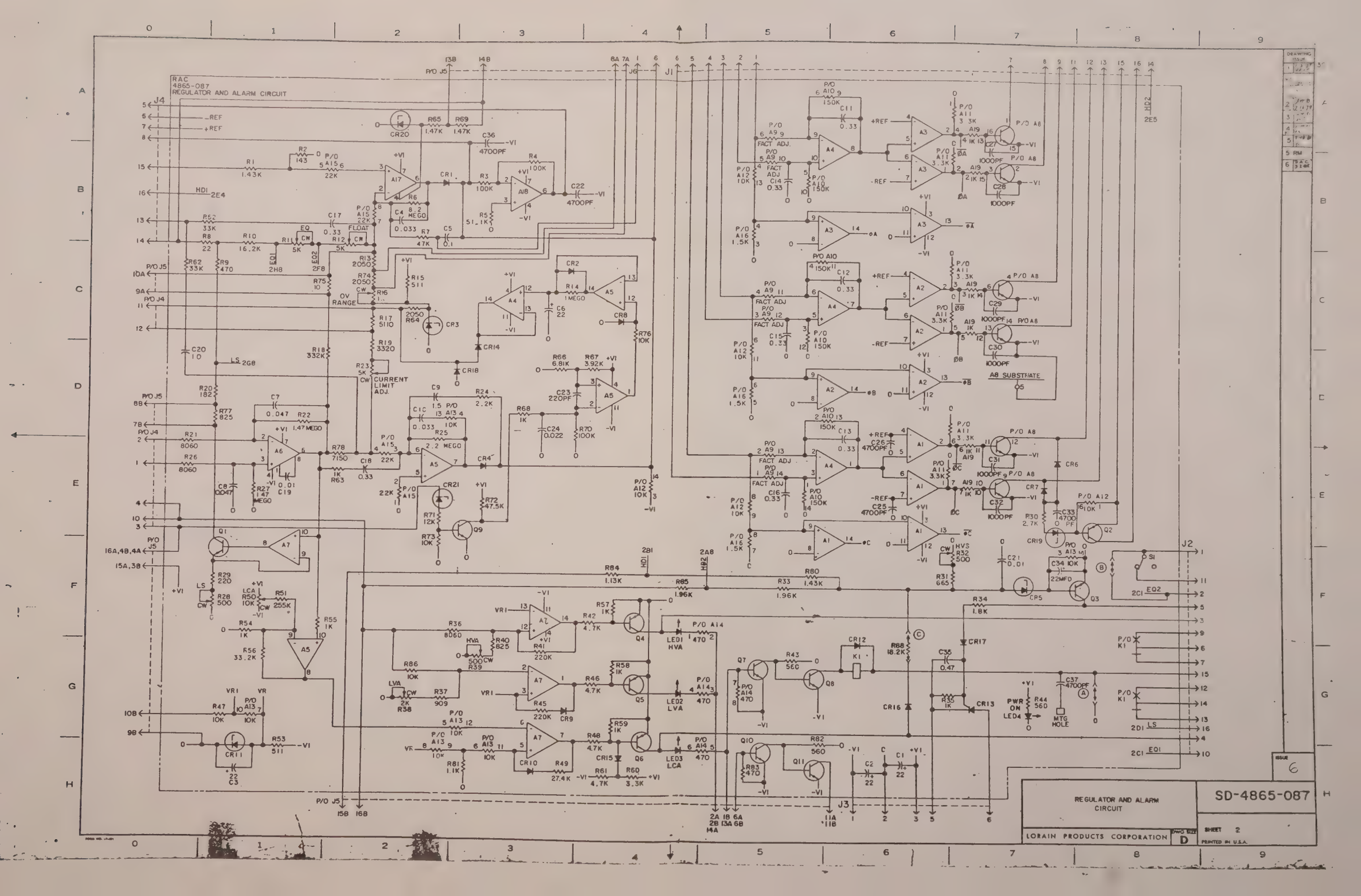
LORAIN PRODUCTS CORPORATION
LORAIN, OHIO
LORAIN PRODUCTS (CANADA) LTD., ST. THOMAS, ONTARIO

DWG SIZE D

SD-4865-087

SHEET 1 OF 2

PRINTED IN U.S.A.


RAC
4865-087
REGULATOR AND ALARM CIRCUIT
REGULATOR AND ALARM CIRCUIT
SD-4865-087
LORAIN PRODUCTS CORPORATION
SHEET 2
PRINTED IN U.S.A.
A8 SUBSTRATE
OV RANGE
CURRENT LIMIT ADJ.
FACT ADJ
PWR ON LED4
MTG HOLE
HVA
LVA
LCA
VR
VR1
LED1 HVA
LED2 LVA
LED3 LCA
J1
J2
J3
J4
J5
J6

COMPONENT LIST

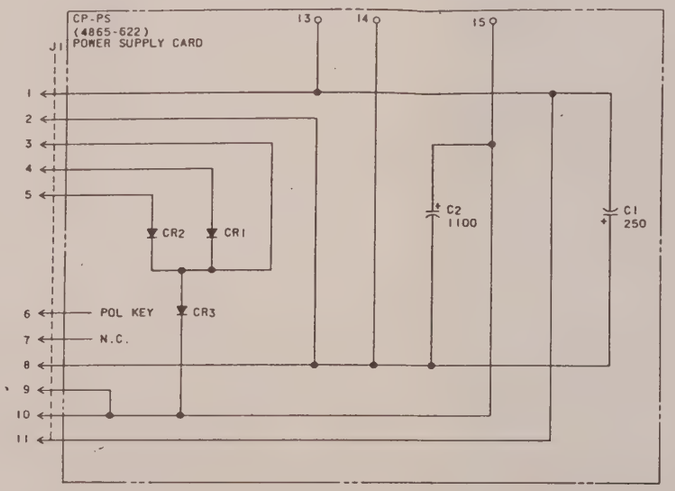
CAPACITOR

DESIG	CODE	
C1	(2731-165)	250UF, 30V
C2	(2731-225)	1100UF, 40V

DIODE

DESIG	CODE	
(3)CR1,2,3	(2812-330)	IN4820

CPS-PS
(POWER SUPPLY)



MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4865-622
P.W. BOARD	3156-197
CONNECTOR ON FRAME	2478-558

SYMBOL

SHOWN IN DETAIL IN FS

CIRCUIT DESCRIPTION

THIS CARD CONTAINS RECTIFIERS AND FILTERS FOR A + 12V POWER SUPPLY.

NOTES:

1. UNLESS OTHERWISE SPECIFIED, CAPACITANCE VALUES ARE IN MICROFARADS, VALUES PRECEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS.
2. CODES WITHIN PARENTHESES, AS (2731-165) REPRESENT LPC PART NUMBERS.

REVISIONS

NO.	CHGD BY THIS SLIP NO.	DATE	DESCRIPTION
1M			NEW DRAWING

181-7009

POWER SUPPLY CARD

DESIGN	J GIANCATERINO	ISS.
DRAWN BY	D CHEVALIER	DATE 2-17-77
CHECKED BY		DATE 3-11-77
CHECKED BY		DATE 3-14-77
APPROVED BY		DATE 4-5-77
RATING	STANDARD	

SD-4865-622

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO
LORAIN PRODUCTS (CANADA) LTD., ST. THOMAS, ONTARIO

OWG SIZE D

SHEET 1 OF 1

COMPONENT LIST

CAPACITORS

DESIG	CODE
C1	(2731-145) 100MFD, 25VDC
C2	(2713-146) .33 MFD, 100 VDC

DIODES

	DESIG	CODE
(5)	CR1-CR5	(2812-310) IN 4818

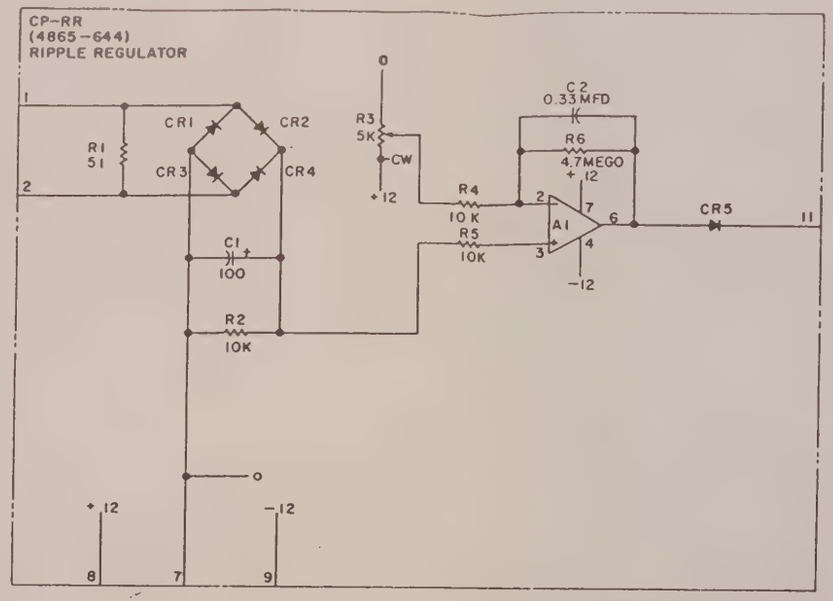
INTEGRATED CIRCUIT

DESIG	CODE
A1	(2871-103) OP-AMP, 741

RESISTORS

	R1	(2651-148) 51 OHMS, 3W
(3)	R2, R4, R5	(2635-673) 10K, 1W, 1%
	R3	(2675-118) 5K, 1/2W, POT
	R6	(2615-351) 4.7MEGO, 1/2W

CPS-RR



MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4865-644
P.W. BOARD	3155-253
CONNECTOR ON FRAME	

SYMBOL
SHOWN IN DETAIL IN F.S.

REVISIONS

			11-13

1 NEW, WAS 184-7076-102, ISS 1

CIRCUIT DESCRIPTION

THE OUTPUT OF A1 OP AMP CHANGES FROM A NORMALLY NEGATIVE VOLTAGE TO A POSITIVE VOLTAGE, PROPORTIONAL TO THE VOLTAGE APPLIED AT R1. R3 ADJUST THE VOLTAGE LEVEL AT WHICH A1 GOES FROM NEGATIVE TO POSITIVE.

NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS; VALUES PRECEDED BY THE SYMBOL + (PLUS) OR - (MINUS) ARE IN VOLTS.
2. CODES WITHIN PARENTHESES, AS (2731-145) REPRESENT LPC PART NUMBERS.

184-7076-102

SCHEMATIC DIAGRAM
FOR
RIPPLE REGULATOR

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO
LORAIN PRODUCTS (CANADA) LTD., ST THOMAS, ONTARIO

DWG SIZE D

DESIGN	J. RADER	ISS. 1
DRAWN BY	J. TUTTLE	DATE 12-19-78
CHECKED BY		DATE
CHECKED BY		DATE 8-30-79
APPROVED BY		DATE 8-30-79
RATING	STANDARD	

SD4865-644

SHEET 1 OF 1

PRINTED IN U.S.A.

COMPONENT LIST

RESISTOR

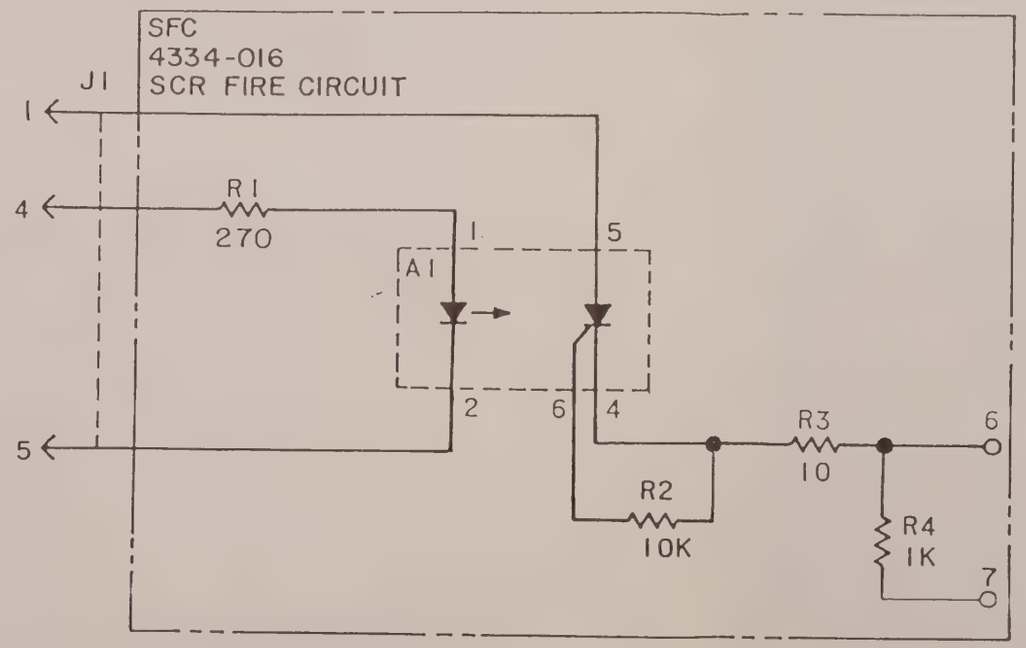
DESIG	CODE
R1	(2615-249) 270 OHM, 1/2W
R2	(2615-287) 10K, 1/2W
R3	(2615-215) 10 OHM, 1/2W
R4	(2651-335) 1K, 3W

INTEGRATED CIRCUIT

DESIG	CODE
A1	(2857-106)

MANUFACTURING REFERENCE

CATEGORY	NUMBER
ASSEMBLY DRAWING	4334-016
P.W. BOARD	3158-178
CONNECTOR ON FRAME	2478-552



CIRCUIT DESCRIPTION

THIS CIRCUIT PROVIDES AN ISOLATED GATE SIGNAL FOR FIRING SCRS.
THE SIGNAL IS GENERATED BY A PHOTO SCR WHEN A CURRENT OF 20 MA IS PASSED THROUGH PINS 4 AND 5

NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS.
2. CODES WITHIN PARENTHESES, AS (2615-257) REPRESENT LPC PART NUMBERS.

REVISIONS

ISS NO	CHGD BY / CHG SLIP NO	DATE	DESCRIPTION
1			NEW
2	1835995	5	CONNECTOR
	L.D.	3	WAS 2465-612.
	L. D. Spangler 5-3-76	76	O.J. Becker 5/4/76 J Mitchell
	RI WAS 2615-257, 560 OHM		
	L. D. Spangler 8-26-76		D Duffy 8-26-76 R Plow 8-27-76
	ISS NO. 3 M1836293 D.S.		8-26-76
3	RM	4-8-81	D.A.C.
	SPELLING CORRECTION		
	M. J. Thome 4-9-81		Dm 4-13-81

DRAWN BY J. REESE	DATE 2-17-76
CHECKED BY L.D. Spangler	DATE 2-18-76
APPROVED BY O.J. Becker	DATE 2/23/76
APPROVED BY J Mitchell	DATE 2.23.76

SCR FIRE CIRCUIT

LORAIN Products Corporation
LORAIN OHIO
LORAIN PRODUCTS (CANADA) LTD.
ST. THOMAS, ONTARIO

DWG SIZE	
B	SD-4334-016
PRINTED IN USA	SHEET 1 OF 1

1. SPECIFICATION

1.1 **GENERAL:** These FLOTROL® Rectifiers -

(A) are designed to power a load while charging batteries in a positively grounded system.

(B) are listed by Underwriters Laboratories Inc. (U.L.) under Standard 1012 for power conversion equipment in a controlled environment.

1.2 **OUTPUT RATINGS**

1.2.1 **Voltage:** Float voltage is adjustable from 48 to 54 volts for floating 23 or 24 cells of battery. Equalize voltage is adjustable from float to 57 volts for equalizing 23 or 24 cells of battery. A front panel-mounted switch selects float or equalize mode of operation.

1.2.2 **Regulation**

(A) **Static:** Steady state output voltage remains within ± 1/2% of any voltage within the range of 48.3 to 55 volts for any load current from no load to full load for the input voltage and frequency ranges specified below.

(B) **Temperature Coefficient:** Output voltage change does not exceed an average of 0.01% per degree C within the ambient temperature range of 0° C to +50° C. Refer to paragraph 1.8.1.

(C) **Dynamic:** For a step load change from 20% to 100% of full load on a 100 amp or 200 amp rectifier or 250 amps within the range of 5% to 100% of full load on a 400 amp rectifier, the maximum voltage transient does not exceed ± 5% of the initial steady state voltage. Recovery to within steady state voltage regulation range does not exceed 200 milliseconds and all transient behavior disappears within 500 milliseconds. Refer to paragraph 1.8.1.

1.2.3 **Filtering**

When connected to a battery rated in ampere-hours four times the full load current rating of the charger,

(A) voice band noise is less than 32 dbrn with C-message weighting

(B) wide band noise does not exceed 500 MV peak to peak or 30 MV RMS over the frequency range of 10 Hz to 14 MHz. Refer to paragraph 1.8.1.

1.2.4 **Current**

Model	Rating
RHM100D50	100 Amps
RHM200D50	200 Amps
RHM400D50	400 Amps

TABLE 1

PD5481-038
PD5472-014

LORAIN PRODUCTS
LORAIN, OHIO
RELIANCE COMM/TEC

POWER DATA

THREE PHASE "RHM" SERIES FLOTROL® RECTIFIERS
MODEL RHM100D50 SPEC. NO. 5454-010
MODEL RHM200D50 SPEC. NO. 5472-014
MODEL RHM400D50 SPEC. NO. 5481-038

ISSUE	CHG NO	DESCRIPTION
13	—	BP SEP 15 1982 PARA. 1.6.5 CLARIFIED Rak 9/15/82 M
12	—	1.6.5 ADDED DD 8-16-82 BP AUG 16 1982
BP MAR 26 1982 11	—	MODEL RHM400E50 SPEC. NO. 5482-022 MADE INTO SEPARATE PD, AND MODELS RHM400D50 SPEC. NOS. 5481-036 AND 5481-037 OBSOLETE.

REVISIONS

DR BY	DATE	GRP LDR	DATE
R. L.	31582	RWHornady	3-25-82
CH BY	DATE	APP BY	DATE
R. Kunish	3/16/82	R. Kunish	3/16/82
ENGR BY	DATE		
JA Giacoletto	3/17/82		

PD5454-010

1. SPECIFICATION

1.3 INPUT RATING

1.3.1 **Voltage:** Taps provided for nominal 208/240 volts, three phase, 57 to 63 Hz, with ranges of 184 to 220 and 212 to 254 volts.

(A) Typical Input Data - Model RHM100D50
(1) 52.08 Volts DC at the Rectifier Output

Input Voltage and Nominal Tap	Amount of Load	Amperes	VA	Watts	VAR	Efficiency	Power Factor
204 Volts on 208 Volt Tap	No Load	1.46	516	140	497	-	-
	Half Load	12.00	4240	2960	3036	88.0%	69.8%
	Full Load	22.80	8056	6140	5215	84.8%	76.2%
235 Volts on 240 Volt Tap	No Load	1.26	513	160	487	-	-
	Half Load	10.00	4070	2960	2794	88.0%	72.7%
	Full Load	19.80	8059	6080	5290	85.6%	75.4%

(2) Maximum Input Current with 56.4 Volts Output at the Rectifier

Nominal Input Voltage	208V	240V
Input Voltage	204V	235V
Max. Input Current	24.6A	21.4A

(B) Typical Input Data - Model RHM200D50
(1) At 52.08 Volts DC at the Rectifier Output

Input Voltage and Nominal Tap	Amount of Load	Amperes	VA	Watts	VAR	Efficiency	Power Factor
204 Volts on 208 Volt Tap	No Load	1.8	636	168	613	-	-
	Half Load	23.7	8374	5860	5982	88.9%	70.0%
	Full Load	46.8	16536	12120	11249	85.9%	73.3%
235 Volts on 240 Volt Tap	No Load	1.1	448	164	417	-	-
	Half Load	20.5	8344	5780	6018	90.1%	69.3%
	Full Load	40.6	16525	11920	11445	87.4%	72.1%

(2) Maximum Input Current with 56.4 Volts Output at the Rectifier

Nominal Input Voltage	208V	240V
Input Voltage	204V	235V
Max. Input Current	51.0A	44.0A

1. SPECIFICATION

1.3 INPUT RATING (CONT'D)

(C) Typical Input Data - Model RHM400D50
(1) 52.08 Volts DC at the Rectifier Output

Input Voltage and Nominal Tap	Amount of Load	Amperes	VA	Watts	VAR	Efficiency	Power Factor
208	No Load	3.5	1260	300	1225	-	-
	Half Load	36.1	13000	11250	6515	92.6%	86.5%
	Full Load	73.9	26620	23000	13400	90.6%	86.4%
240	No Load	3.4	1415	244	1390	-	-
	Half Load	31.7	13180	11260	6850	92.5%	85.4%
	Full Load	63.6	26440	23000	13040	90.6%	87.0%

(2) Maximum Input Current with 56.4 Volts Output at the Rectifier

Nominal Input Voltage	208V	240V
Input Voltage	184V	212V
Max. Input Current	92.8A	81.0A

1.3.2 **Efficiency:** Greater than 85% from 50% load to full load at the design center input voltage of any tap at 60 Hz input and 50 volts output.

1.3.3 **Displacement Factor:** For a 100 amp or 200 amp rectifier, the displacement factor is greater than 65% and for a 400 amp rectifier, is greater than 80% from 40% load to full load at the design center input voltage of any tap at 60 Hz input and 50 volts output.

1.3.4 **Telephone Influence Factor:** The IT product does not exceed the values in Table 2 for any normal input and output condition. Refer to paragraph 1.8.1.

Model	IT Product
RHM100D50	17500
RHM200D50	15000
RHM400D50	35000

TABLE 2

1.3.5 **Distortion:** The peak to peak amplitude of any distortion in the line to line AC voltage wave does not exceed 10% of the fundamental rms voltage if the AC source impedance produces no more than 2% voltage drop when the charger is delivering full load. Refer to paragraph 1.8.1.

1. SPECIFICATION

1.4 STANDARD FEATURES

1.4.1 **Power Circuit:** Delta-double wye connected six phase rectifier.

1.4.2 **Input Protection:** A three pole switch opens all three input lines.

1.4.3 Output Protection

(A) **Current Limiting:** A circuit, adjustable from 90% to 110% of full rated load, limits DC output current. Factory set at 110% of full load.

(B) **Short Circuit:** Fuses listed in Table 3 are located in the negative output lead.

Model	Short Circuit Protection	Type
RHM100D50	150 Amp	Gould-Shawmut A25Z150
RHM200D50	250 Amp	Gould-Shawmut A25Z250
RHM400D50	600 Amp	Gould-Shawmut A25Z600

TABLE 3

(C) **Overvoltage Shutdown:** A load protection circuit will cause rectifier shutdown should rectifier output voltage exceed a preset value while the rectifier is delivering at least 3% of rated output current. Unless otherwise specified, factory set at value listed in Table 4.

1.4.4 **Local or Remote Voltage Sensing:** Point of regulation may be extended to battery or power board terminals.

1.4.5 **Alarms** - Relay contacts are rated one ampere at 26 volts.

(A) RECTIFIER FAIL ALARM: If the rectifier is turned off manually, or automatically by a high voltage condition, or if the rectifier is disabled by loss of AC input power, an input overcurrent condition, fan failure (if provided), or operation of output fuse F1 or reference fuse F2, positive battery is provided for two external rectifier fail alarm circuits. A closed loop actuated alarm is available as a wiring option.

(B) LOW CURRENT ALARM (LED): If output current decreases below 0.5% of full load (known as charge failure), or if the rectifier is turned off, the Rectifier Fail Alarm circuit will activate, the yellow Low Current Alarm indicator will illuminate, and positive battery will be provided for an external low current alarm circuit. A closed loop actuated alarm is available as a wiring option.

(C) HIGH VOLTAGE ALARM (LED): If output voltage increases above a preset level, the Rectifier Fail Alarm circuit will activate and the red High Voltage Alarm indicator will illuminate.

(D) LOW VOLTAGE ALARM (LED): If output voltage decreases below a preset level, the Rectifier Fail Alarm circuit will activate and the red Low Voltage Alarm indicator will illuminate.

(E) FUSE ALARM (LED): Operation of output fuse F1, reference fuse F2 or filter capacitor fuse F3 and F4 (if furnished) causes a red alarm LED to turn on. Operation of fuses F1 and F2 will also activate the Rectifier Fail Alarm.

Model	Low Voltage Alarm		High Voltage Alarm		Overvoltage Shutdown	
	Range	Factory Setting	Range	Factory Setting	Range	Factory Setting
RHM100D50 RHM200D50 RHM400D50	39.1V to 52.8V	47.15V	52.8V to 60.0V	57.6V	52.8V to 60.0V	55V

1. SPECIFICATION

1.4 STANDARD FEATURES (CONT'D)

1.4.6 Indicators

(A) POWER ON (LED): When the AC INPUT non-automatic circuit breaker (S1) is in the ON position and AC input is present, the green Power On indicator will illuminate.

1.4.7 **Load Sharing:** A circuit is furnished to obtain proportional division of load with other LORAIN FLOTROL Rectifiers which are equipped with compatible negative bus load sharing circuits and can be adjusted to the same output voltage.

1.4.8 **Remote Equalize:** Provision is made for remote control of Float-Equalize operation. Refer to Section 3, INSTALLER'S CONNECTIONS and Note 4.9.

1.4.9 **End Cell Charging:** The output voltage can be increased for any tap at its nominal voltage for charging three end cells by switching the DC output and leaving the reference connected across the main 23 cell string.

1.4.10 **Phase Shift (400 amp only):** Main power transformer shifts the phase of input current to lower line distortion when two units are operated in parallel. Refer to paragraph 1.8.1.

1.4.11 **Thermal Protection (400 amp only):** Circuit is provided to reduce load carrying capability to 66% of full rated load and give a rectifier failure alarm when the temperature of air flow through the rectifier reaches +75° C (+167° F) or if the temperature of the heatsink reaches +85° C (+185° F) in the 400 amp rectifier.

1.4.12 **Current Walk-in:** Output current will be gradually increased to no greater than 50% of full load in 2.5 seconds, 75% of full load in 5.0 seconds and 90% of full load in 8.0 seconds.

1.4.13 **Emergency Restoration:** This rectifier may be started when connected to a dead or nearly dead battery.

1.4.14 **Meters:** MODUTEC Type W (or equivalent), 3 1/2 inch rectangular type DC voltmeter and ammeter, ± 2% accuracy at full scale with ranges as listed in Table 5.

Model	Meter Ranges	
	Ammeter	Voltmeter
RHM100D50	0-150 Amp	0-75 Volt
RHM200D50	0-300 Amp	
RHM400D50	0-600 Amp	

TABLE 5

1.4.15 **Mounting:** Angles are provided to mount the RHM100D50 on 19"/23" relay rack and the RHM200D50 on 23" relay rack only. The RHM400D50 is floor mounted only.

1.4.16 **Output Disconnect:** A switch is provided to open the negative DC output bus.

1.5 ENVIRONMENTAL RATING

1.5.1 **Ambient Operating Temperature Range:** 0° C to +50° C (+32° F to +122° F)

1.5.2 **Storage Temperature Range:** -40° C to +85° C (-40° F to +185° F)

1.5.3 **Humidity:** This rectifier is capable of operating in an ambient relative humidity of 10% to 95%.

1.5.4 **Altitude:** This rectifier is capable of operating at altitudes from sea level to 10,000 feet at ambient temperatures of +45° C (+113° F) at 4800 feet and +40° C (+104° F) at 7000 feet.

1.5.5 **Ventilation Requirements:**

(A) Rectifier should be mounted so that ventilating openings are not blocked and air entering the cabinet does not exceed +50° C (+122° F).
(B) Relay Rack Spacing: It may be necessary to allow spacing listed in Table 6 and use a baffle plate between this rectifier and other heat producing equipment.

1.5.6 **Heat Dissipation:** Refer to Table 6.

Model	Heat Dissipation BTU/HR	Relay Rack Spacing	Floor Mounting
RHM100D50	3185	5 1/4"	-
RHM200D50	5825		-
RHM400D50	7400	-	Yes

TABLE 6

1.5.7 **Conducted Radio Frequency Interference:** Conducted radio frequency interference voltages in the frequency range of 150 KHz to 25 MHz on the AC input and DC output power lines will not exceed the broad band conducted radiation of the NEMA Standard and MIL-I-6181D. Refer to paragraph 1.8.1.

1.5.8 **Audible Noise:** The audible noise at any point five feet from any vertical surface of the rectifier does not exceed 60 dB "A" weighting when measured with a General Radio 1551-C Sound Level Meter (or equivalent) conforming to ANSI S1.4. Refer to paragraph 1.8.1.

1. SPECIFICATION

1.6 ACCESSORIES AVAILABLE FOR USE WITH THIS RECTIFIER

1.6.1 Mountings

(A) Adapter Plates for 30 inch Unistrut Relay Rack: RHM100D50 and RHM200D50: (2) of Part No. 3471-533
(B) Floor Stands (replace relay rack angles)
  (1) RHM100D50: (1) of Part No. 3772-190
  (2) RHM200D50: (1) of Part No. 3772-189

1.6.2 Baffle Plates

(A) 19" Baffle Plate, 5 1/4" rack space: (1) of Part No. 3777-616
(B) 23" Baffle Plate, 5 1/4" rack space: (1) of Part No. 3777-617

1.6.3 Equalize Charge Timer:

(A) **Manual Equalize Charge Timer:** (1) of Part No. 4843-824. Manually adjustable timer to permit equalize time periods of up to 24 hours. Arranged for 19" or 23" relay rack mounting (1" and 1 3/4" multiple drilling), or wall mounted. Adapters are also furnished for mounting in 27 1/2 and 30" channel type relay rack. The charge timer can control a maximum of four FLOTROL Rectifiers.

(B) **Automatic Equalize Charge Timer:** (1) of Part No. 4843-825. This timer continuously monitors rectifier operation. In the event of a rectifier or AC power failure which causes battery voltage to decrease below normal float voltage, a timer circuit is activated. Upon restoration of normal rectifier operation the timer circuit will automatically cause the rectifier to equalize charge the battery for a predetermined time period. This charge timer is designed for 19" relay rack mounting. To mount the charge timer in a 23" relay rack, specify (2) 3471-102 adapter plates. The charge timer can control a maximum of eight FLOTROL Rectifiers.

1.6.4 **External Battery Eliminator Filter -** When using this accessory, Voice Band Noise Filtering specification is -Noise is less than 32 dBrn C message weighting without battery.

(A) RHM100D50: (1) of Part No. 4826-158
(B) RHM200D50: (1) of Part No. 4826-162
(C) RHM400D50: (1) of Part No. 4826-160

1.6.5 **1' - 0" Extension Assembly (Model RHM400D50 only),** (1) of Part No. 4133-045. This assembly extends the height of the rectifier cabinet to 7 feet, providing support for buswork or cable rack. This assembly also improves the appearance of an installation when the rectifier is installed adjacent to 7' high relay racks or box frameworks.

1.7 MISCELLANEOUS

	RHM100D50	RHM200D50	RHM400D50
1.7.1 Schematic Diagram:	SD5454-010	SD5472-014	SD5481-038
1.7.2 Wiring Diagram:	T5454-010	T5472-014	T5481-038

1.7.3 Instructions: Section 3846

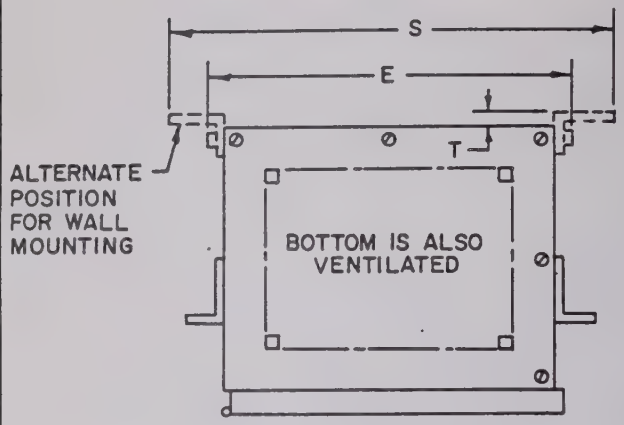
1.8 SPECIFICATION NOTES

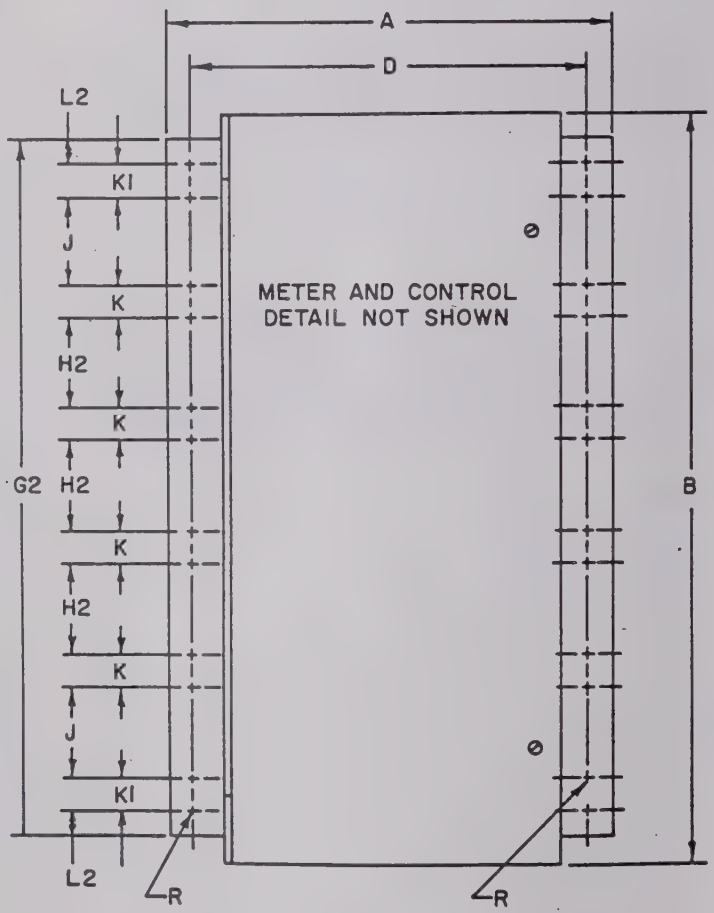
1.8.1 This parameter is guaranteed by Engineering Design and test. Parameter is not production tested.

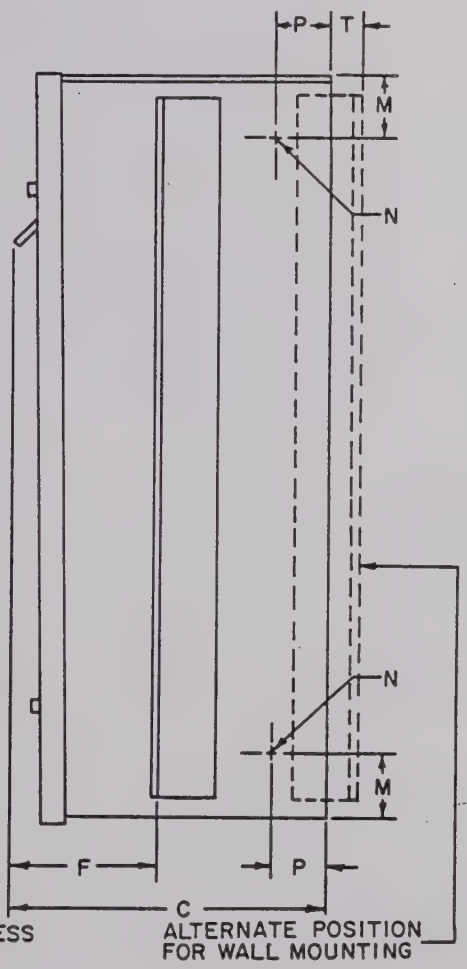
2. DIMENSIONS – RHM100D50, RHM200D50

Dimension Designation	RHM100D50	RHM200D50
A	19/23	23
B	36 7/16	36 1/16
C	13 3/4	14 13/16
D	18 5/16 22 5/16	22 5/16
E	17 1/8	21 1/4
F	4 3/4	5 15/16
G1	—	—
G2	36	36
H1	—	—
H2	5 3/4	5 3/4
J	4	4
K	1 1/4	1 1/4
KI	1 3/4	1 3/4
L1	—	—
L2	1 1/8	1 1/8
M	2 1/4	2 7/16
N	(2) 3 hole*	(2) 3 hole*
P	2 3/4	2 3/4
R	0.281 x 0.500 Slot	
S	23	23
T	13/32	1 3/32

* Holes are covered with (4) 3 1/4 x 3 1/4 steel plates. Two plates are equipped with 7/8", 1-3/8", 2" triple K.O.; two plates are equipped with 1-1/8, 1 3/4", 2-1/2" triple K.O.







NOTES:

1. ALL DIMENSIONS ARE IN INCHES, UNLESS OTHERWISE SPECIFIED.
2. WEIGHT (LBS)

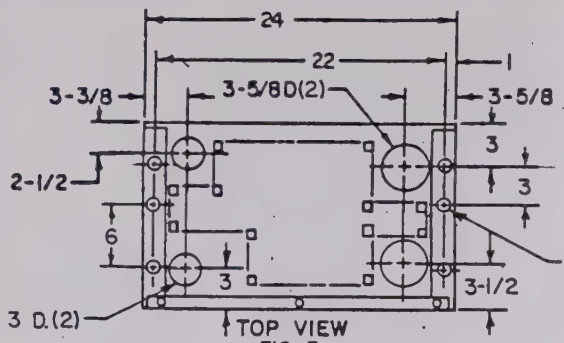
	RHM100D50	RHM200D50
NET	266	451
SHIPPING	272	457

3. FINISH: EQUIPMENT LIGHT GRAY
4. ▭ INDICATES VENTILATING GRILLE

PD5481-038
PD5472-014

PD5454-010

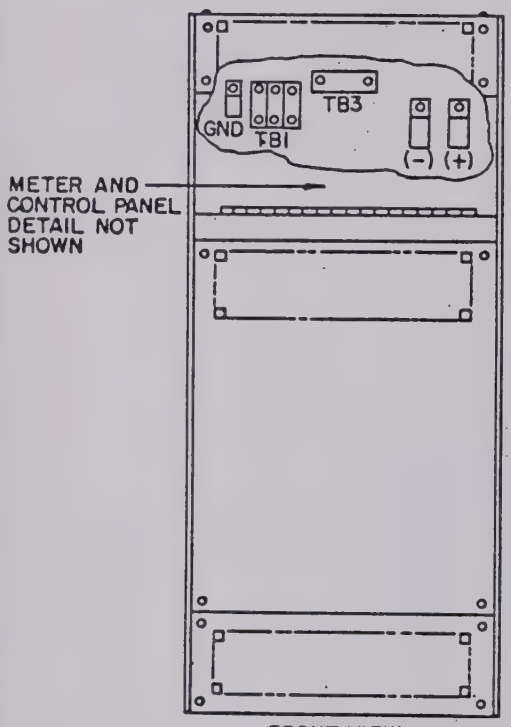
2. DIMENSIONS MODEL RHM400D50



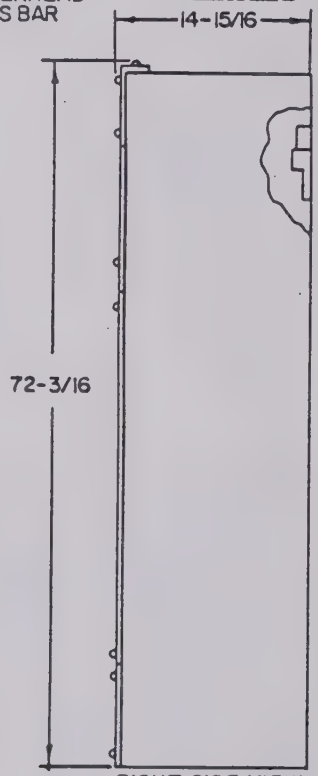
TOP VIEW
FIG 3

NOTES:
1. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
2. WEIGHT
   A. SHIPPING: 712 LBS
   B. NET: 647 LBS
3. FINISH: EQUIPMENT LIGHT GRAY

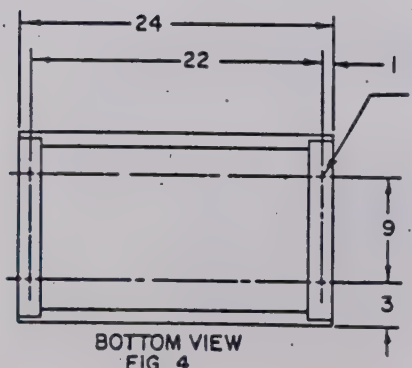
4. INDICATES VENTILATING GRILLE



FRONT VIEW
FIG 1



RIGHT SIDE VIEW
FIG 2

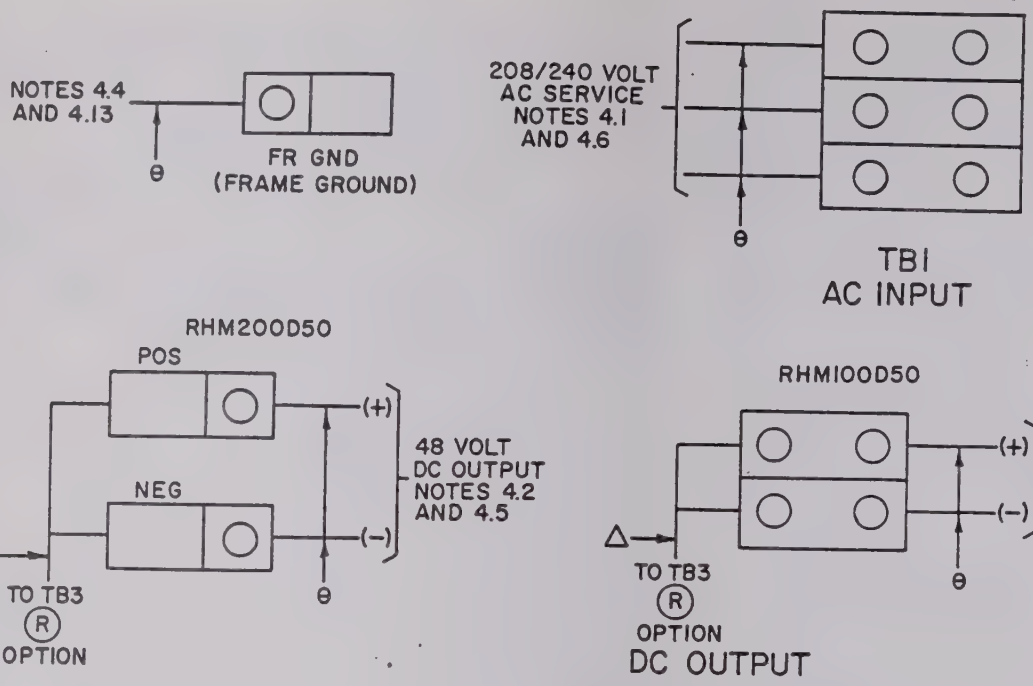


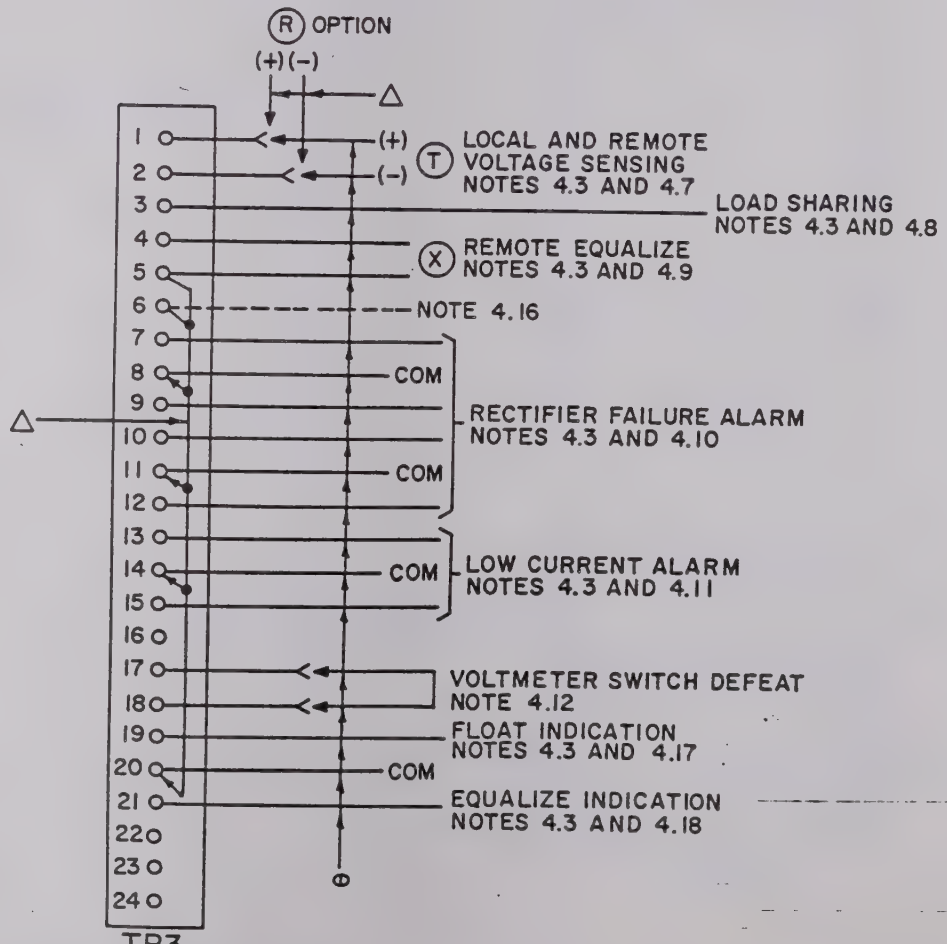
BOTTOM VIEW
FIG 4

PD5481-038
PD5472-014

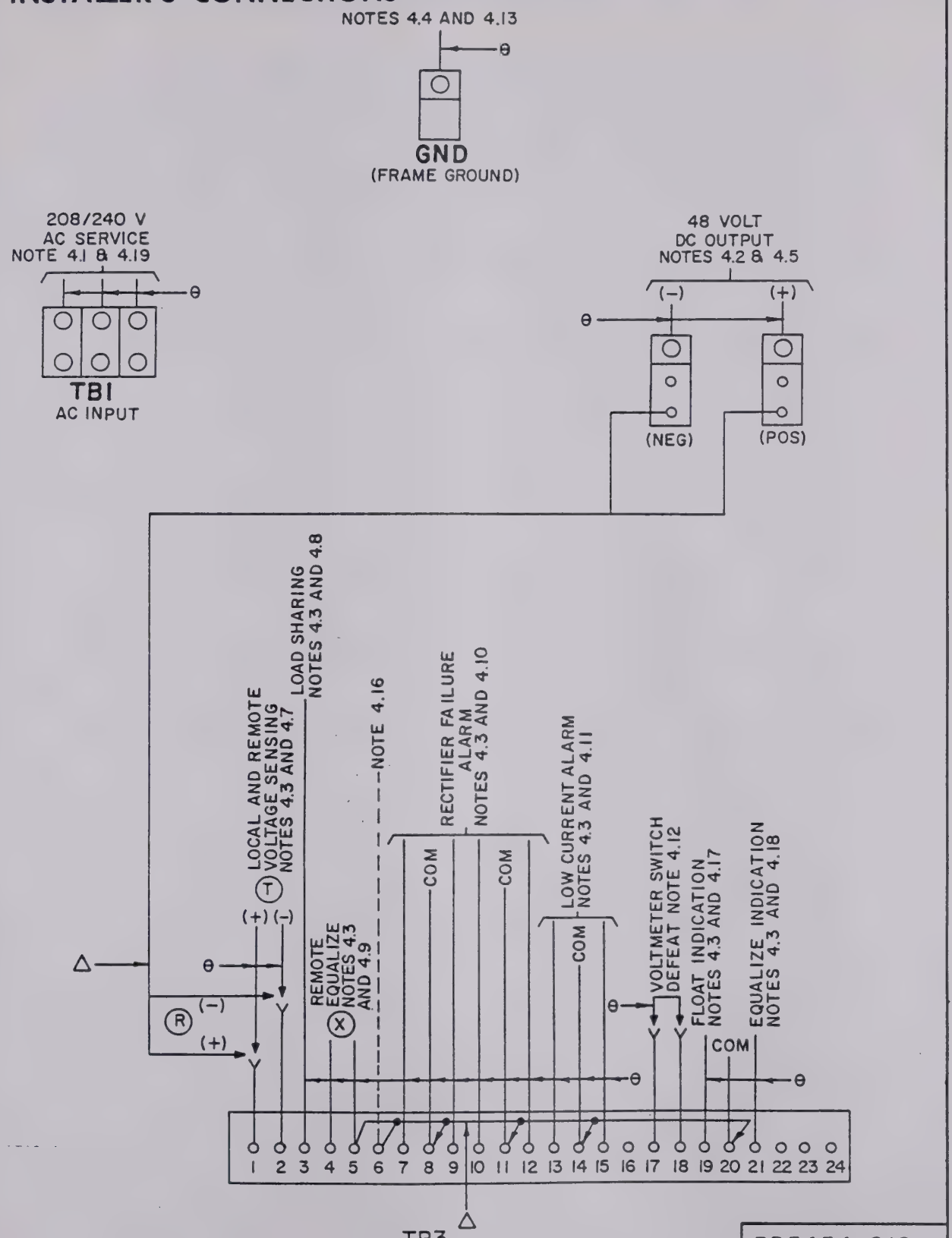
PD5454-010

3. INSTALLER'S CONNECTIONS – RHM100D50, RHM200D50





3. INSTALLER'S CONNECTIONS – RHM400D50



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4. INSTALLER'S INFORMATION NOTES

4.1

AC INPUT (TB1)					
	Terminals		Voltage	Recm	Recm
Model	Capacity	Type		Wire Size	Fusing
RHM100D50	(1) 18 Ga. to 2 Ga. per Phase	Solder-less	208 240	(1) 10 Ga. per Phase	30 Amp
RHM200D50			208 240	(1) 6 Ga. per Phase	60 Amp
RHM400D50	(1) 4 Ga. to 2/0 per Phase	Solder-less	208 240	(1) 3 Ga. per Phase	100 Amp

4.2

DC OUTPUT				
	Terminals		Loop Length	Recm
Model	Capacity	Type	Ft	Wire Size
RHM100D50	(1) 4 Ga. to 2/0 per Pole	Screw	60 95 120	2 Ga. 1/0 2/0
RHM200D50	(1) 600 MCM to 2 Ga. per Pole	Solderless	75 95 112	3/0 4/0 250 MCM
RHM400D50	(1) 600 MCM to 2 Ga. per Pole		135	600 MCM

4.3

ALARM AND CONTROL (TB3)		
Terminals		Recm
Capacity	Type	Wire Size
16 Ga. Max.	6-32 Screw	18 Ga. Max.

4.4

FRAME GROUND (FR GND)			
	Terminals		Recm
Model	Capacity	Type	Wire Size
RHM100D50	6-14 Ga.	Solderless	10 Ga.
RHM200D50			
RHM400D50	8-2 Ga.		8 Ga.

4. INSTALLER'S INFORMATION NOTES

4.5 DC output wire size sufficient to restrict voltage drop to one volt or less at rated full load output current for the loop lengths shown. The loop length is the sum of the lengths of the positive and negative leads.

4.6 Wire sizes meet those recommended in the 1981 National Electric Code Table 310-16 for +75° conductor temperature.

4.7 For remote voltage sensing, remove jumpers ("R" Option) and extend wires from terminals 1 and 2 to the battery ("T" Option). Extended wires should be fused at one ampere.

4.8 Connect this lead to the load sharing (paralleling) terminal on similarly equipped FLOTROL Rectifiers.

4.9 Extension of customer furnished circuit ("X" Option) from terminals 4 and 5 allows remote equalize mode of operation of the rectifier. Customer furnished circuit closure is required to place rectifier into equalize mode of operation.

4.10 If the rectifier is turned off, fan failure (if provided), low current, low output voltage, high output voltage, loss of input power, operation of the reference or output fuse is indicated by furnishing positive battery at terminals 7 and 10 of terminal board TB3.

4.11 Low current alarm condition is indicated by removing positive battery from terminal 13 (End Cell Switch Inhibit Signal) and furnishing positive battery at terminal 15 of terminal board TB3.

4.12 Voltmeter reads battery voltage with the rectifier turned off if terminals 17 and 18 are connected together.

4.13 Connect this wire to earth ground (green wire).

4.14 ⊖ - indicates wires furnished and connected by the installer.

4.15 △ - indicates wires furnished as a part of this rectifier.

4.16 Positive battery is available at terminal 6 of terminal board TB3 for voltage actuated alarms.

4.17 Positive battery is supplied at terminal 19 of terminal board TB3 when the rectifier is placed in float mode of operation.

4.18 Positive battery is supplied at terminal 21 of terminal board TB3 when the rectifier is placed in equalize mode of operation.

4.19 To shift the phase of the input voltage of the rectifier with respect to the AC line service to lower the cumulative distortion on the AC line when two or more rectifiers are operated in parallel, simply interchange any two input phases at the input terminal block TB1. When more than two rectifiers are operated in parallel, interchange any two AC input phases at TB1 on alternate rectifiers.

FOR PARTS OR SERVICE, CONTACT THE NEAREST

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ATTN: _____ TITLE: _____

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Data Sheet For A.E. Approved Rectifiers

Model No.	Spec. No.	Serial No.	Date Tested	Tested By
RHM100D50	5454-010	1077	1-6-83	J.E.D.

Range Checks

Float Voltage Range Check, 45.61 VDC to 58.98 VDC.
Set Float to 52.08 VDC.

Equalize Voltage Rnage Check, 52.08 VDC to 66.32 VDC.

Alarm Checks

High Voltage Shutdown, set at 54.91 VDC.

	Yes	No
Charger Failure Alarm operative?	✓	
AC Fail Alarm, (Power on lamp off)?	✓	
Low Current Alarm operative?	✓	

Regulation Checks

Float Voltage: High input, no load 52.10 VDC.
Low input, full load 51.82 VDC.

Equalize Voltage: High input, no load 59.00 VDC.
Low input, full load 57.70 VDC.

Load Sharing Check

Negative Load Sharing Voltage:
Nominal Input full load, 8.00 (8.00V)

Nominal Input no load, 0.16 (<0.25V)

Positive Load Sharing Voltage:
Nominal Input full load, — (2.0V)

Nominal Input no load, — (10.0V)

Current Limit Check

Current Limit Range Check, 90 amperes to 125 amperes,
Factory set at 110% of full load, or 110 amperes.

Noise

Voice Band Noise 7.8 DBRN C

RMS Noise — MV RMS